A

PROJECT REPORT

ON

“A Survey Report on OH Transmission System: Design & Estimation”

Submitted in partial fulfillment of the award of

DIPLOMA

IN

ELECTRICAL ENGINEERING

Submitted By

Ram Singh	2822115002
Goldi Kashyap	2822115001
Shoeb	1722115001

SUPERVISIOR	**PROJECT GUIDE**
Er. Mohd Faraz Khan	Er. Mohammad Yasir

SESSION 2019-2020

Department of Electrical Engineering

University Polytechnic, Shahjahanpur

INTEGRAL UNIVERSITY, LUCKNOW

CERTIFICATE

This is to certify that this team which is comprised of five students of final year **DIPLOMA IN ELECTRICAL ENGINEERING** in this University Centre is presenting a project on **“A Survey Report on OH Transmission System: Design & Estimation”** as our final year project during the session 2019-2020.

This project is completed for the award **of DIPLOMA IN ELECTRICAL ENGINEERING** from Integral University Centre, Shahjahanpur.

(Project Supervisor/HoD)
Er. MOHD. FARAZ KHAN

(Project Guide)
Er. MOHAMMAD YASIR

Electrical Engineering Department
Integral University-Lucknow
Campus Shahjahanpur

ACKNOWLEDGEMENT

We would like to express my sincere thanks to my project Guide **Er. Mohammad Yasir (Lecturer),** Department of Electrical Engineering, University Polytechnic Shahjahanpur Centre, for his constant support, timely help, guidance, sincere co-operation during the entire period of my work. We are also grateful to him for providing all the necessary facilities during the course of the project work.

We would also like to pay our special thanks to our project supervisor **Er. Mohd. Faraz Khan (HoD),** Department of Electrical Engineering, University Polytechnic Campus, Shahjahanpur for his outstanding help provided during various stages of the project.

Our special thanks goes to In-charge of our Polytechnic **Dr. Mohd. Naseem.** At last but not the least we are want to present our gratitude to **Er. Farazuddin Siddiqui** & **Er. S.A. Rafey** for their full support from time to time in making this project. Apart from this **Mr. Irfan Khan (Lab Instructor)** are also indebted to my heartily thanks for his constant instruction during the whole session in project Lab.

We are also thankful to my loving parents and my colleagues for their moral support & timely help.

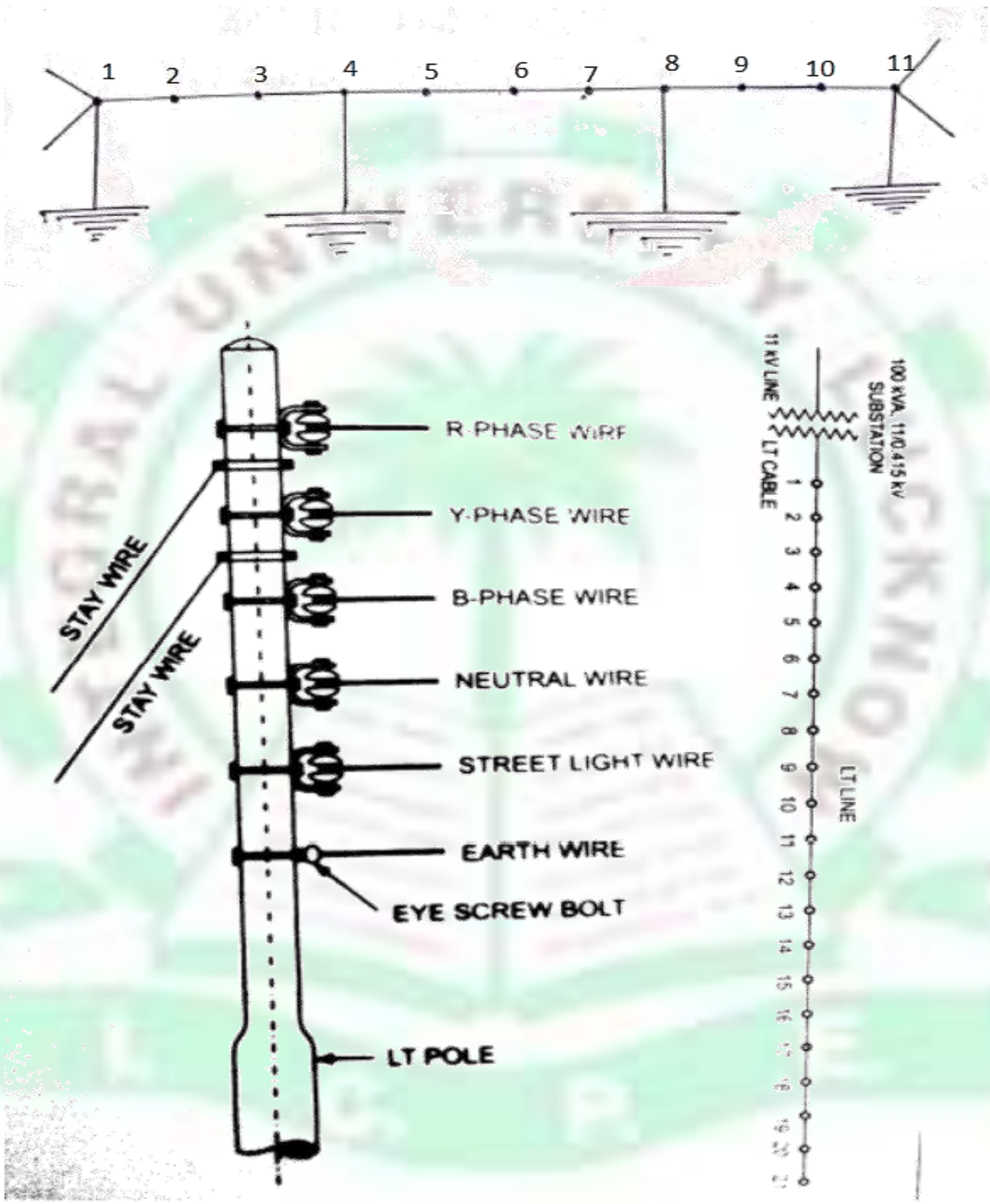
Ram Singh	Goldi Kashyap	Shoeb
2822115002	2822115001	1722115001

ABSTRACT

This work presents the complete practical design & estimation model of OH transmission line for Rural Electrification project along with Bunched cable replacing of it. Through this replacing we can easily understand the other related work like Repairing & Maintenance. The design, construction of a given single phase 11KV Transmission System & Replacing of it with bunched cable in the nearby Rural areas of Bareilly Region. AC transmission line for a practical life power model capable of studying various types of Mechanical & Electrical components, are presented in installing & also replacing this model to the Bunched Cable model. Custom also made inductors, capable of handling short circuit currents, with off the shelf capacitors are used to model and construct the transmission line. The transmission system will be part of a practical life power system model to serve as a teaching aid.

This work also presents a review of the literature on Design & Estimation of Transmission lines & Bunch cable replacing in the given power systems. While covering works related to Design & Estimation in transmission systems, the main focus of this thesis is on Bunched Cable which is installed through the replacing of old Conventional Cable. The scope of project includes mathematical problem formulation, application of pseudo-measurements, metering instrument placement, network topology issues, impacts of renewable penetration, and switchgear security are also discussed. Both conventional and modern project are compared with respect to the current scenario of Bunched cable application in India specially for rural areas. This work can help researchers, scholars and utility/site engineers with insights into the technical achievements, barriers, and future research in this direction.

LAYOUT OF THE PROJECT



LIST OF MAIN COMPONENTS

S.N.	NAME OF MATERIALS	SPECIFICATION
1	POLES	Rail, RCC & Steel
2	STAY SET	With guy wire, plate set, insulator etc
3	ACSR BUNCHED CABLE	STD
4	EPOXY RESIN KIT	3M SCOTCHCOST LV
5	BASE STONE	300X300X7.5mm
6	DANGER PLATE	1000V, W&R, TIE, 200 x 250
7	BARBED WIRE	GIS wire of size 2.5mm dia (for line wire) and 2.0 mm dia (for point wire)
8	CROSS ARM	With two holes & 22mm dia
9	Lightening Arrester	11KV
10	CEMENT CONCRETE	1:2:4
11	PIN INSULATOR	STD
12	DISC INSULATOR	STD
13	C-CLAMP	STD
14	GI-WIRE (50mm)	6SWG & 8SWG & 10SWG
15	I-BOLT	12x110mm
16	EARTH CLAMP	STD
17	PIPE EARTHING SET	STD
18	ALUMINIUM TAPE	0.77x6.4mm
19	BOLT, NUT, WASHER	As per Requirement
20	PIPE EARTHING SET	STD
21	ACSR CONDUCTOR	6/1.2X2.59
22	ANGLE	50X50X6
23	AREAL BUNCHED CABLE (ABC)	LV
24	Inter-Phase Spacers	15KV

OVERVIEW

Title of the Project:

A Survey Report on OH Transmission System: Design & Estimation

Domain:

Transmission
Design & estimation
Power System

Software:

N/A

Land Area:

645 km²

Elevation:

215 m

Estimated Project Cost (in lacs):

11

Total Time:

2 Years

Transformer:

230 V / 12 V AC

Applications:

For Automated Interconnected Power System.
For Self-operated Power Grid
For Power System Networks

INTEGRAL UNIVERSITY, LUCKNOW

TABLE OF CONTENTS

CIRTIFICATE **i**

ACKNOWLEDGEMENT **ii**

ABSTRACT **iii**

LAYOUT DIAGRAM OF THE PROJECT **vi**

LIST OF MAIN COMPONENTS **v**

OVERVIEW **vi**

TABLE OF CONTENTS **vii-viii**

Chapter 1: ABOUT PROJECT **1-3**

1.1 INTRODUCTION 1

1.2 STATEMENT OF PURPOSE 1

1.3 AIM OF THE PROJECT 2

1.4 THESIS OF ORGANIZATION 2

Chapter 2: BASICS OF ESTIMATING & COSTING **4-13**

2.1 PURPOSE 4

2.2 PRINCIPLE 5

2.3 MARKET SERVEY& ESSENTIALS 6

2.4 BASIC TERMINOLOGIES 7

Chapter 3: BASICS OF OH TRANSMISSION SYSTEM **14-19**

3.1 INTRODUCTION 14

3.2 COMPONENTS OF TRANSMISSION SYSTEM 14

3.3 INSTALLATION & MAINTENANCE 17

3.4 TOOLS USED IN TRANSMISSION SYSTEM 18

Chapter 4: SURVEYING AND CIVIL WORK **20-26**

4.1 PREPLANNING 20

4.2 OPTIMIZING POLE LOCATION 21

4.3 ERECTION OF POLES 21

4.4 WATER CEMENT RATIO 25

Chapter 5: IE RULES AND PREPLANNING **27-37**

5.1 PREPLANNING 27

5.2 FOR POWER TRANSMISSION LINES 31

5.3 FOR REPAIRING & MAINTAINANCE 32

5.4 FOR BUNCHED CABLE REPLACEMENT 32

Chapter 6: AREA WISE INSPECTION & SERVEY DATA **38-42**

3.1 INTRODUCTION 38

3.2 AREA WISE REPORTS 39

3.3 CALCULATIONS 41

Chapter 7: CONCLUSION & FUTURE SCOPE **43-44**

7.1 CONCLUSION 43

7.2 FUTURE SCOPE 44

REFERENCES **45-46**

APPENDIX

UNIVERSITY, LUCKNOW
I C P E

Chapter 1: ABOUT PROJECT **1-3**

1.1 INTRODUCTION 1

1.2 STATEMENT OF PURPOSE 1

1.3 AIM OF THE PROJECT 2

1.4 THESIS OF ORGANIZATION 2

CHAPTER-1: ABOUT PROJECT

In this chapter the basic introduction about the Concept of Site project work of Transmission line installation including it's aims, statement of purpose & thesis organization is given in short.

1.1 INTRODUCTION

The term Transmission Lines broadly refers to overhead transmission lines and underground cables. While in General UG Cables are referred as Power Cables. The key function of an OH transmission line is to transfer bulk power between generation sources and load centers. UPPTCL owns, manages and operates transmission lines at 132kV, 66kV & 11KV. Transmission Lines are made up of various components, namely poles, lattice structures, conductors, cables, insulators, foundations and earthing systems. These components are described in more detail in this document.

This Survey Project deals with the complete inspection of OH transmission line installation pertaining to the general requirements related to its installation, Typical Overhead Line Structures, inspection, reaping & maintenance along with the replacement of these old conventional OH ACSR conductor by Areal Bunched Conductor (ABC). The purpose of this report is to provide a high-level summary of the various stages during the both projects. Primary and secondary functions of transmission line components are also provided for context.

1.2 STATEMENT OF PURPOSE

The UPPTCL transmission planning process focuses on making the benefits of an economically efficient electricity available to customers of Rural areas by identifying transmission projects that provide access to electricity at the lowest total electric system cost. As a part of this process, UPPTCL identifies essential transmission projects that will improve the reliability and efficiency of energy delivery in the particular rural area of any one state region. These projects are included in the UPPTCL Transmission Expansion Plan, an annual publication that is collaboration between UPPTCL planning staff and Private stakeholders. Certain types of projects as identified in UPPCL require cost estimates to justify the business case for recommendation to Board of Electricity. UPPTCL provides cost estimates for these certain types of projects in order to evaluate alternatives. UPPCL's transmission cost estimation guide for 2019 describes the approach and cost data that UPPCL uses in developing its cost estimates. This document's assumptions and cost data are reviewed yearly with Private stakeholders. All cost estimate data in this document are in 2019 INR and are inclusive of all applicable all taxes. In general, costs were escalated 2.5% from values shown in UPPCL's cost estimation guide for Electricity Regulation 2018.

The costs of a OH Transmission line to be constructed to the owner include both the initial capital cost and the subsequent operation and maintenance costs. Each of these major cost categories consists of a number of cost components. The capital cost for a OH project includes the expenses related to the initial establishment.

While the costs of a Bunched cable replacement of given OH Transmission line to the owner includes only the replacement cost considering the same operation and maintenance costs as per estimated for previous installation.

1.3 AIM OF THE PROJECT

The billions of dollars are being invested in new projects across the americas, europe and africa to develop robust transmission infrastructure to meet the growing electricity demand. We take a closer look at a minor transmission line project in Fareedpur Region of Bareilly Region under rural power installation and development enterprise by UPPTCL.

The main aim of this project is to summarize all site work in a single survey report. The primary function of transmission line conductor systems is to transfer electrical power between designated locations, within prescribed performance, operating and environmental conditions. While the Secondary functions of transmission line conductors are to:

a) Maintain electrical safety and minimize adverse effects on the environment

b) Provide a whole-of-life cost-effective service.

Due to various major problems of load shedding due to Electricity theft the technology of Areal Bunched Conductor (ABC) is to be used over these OH Projects as another assignment on it.

A major goal of overhead power line design is to maintain adequate clearance between energized conductors and the ground so as to prevent dangerous contact with the line, and to provide reliable support for the conductors, resilience to storms, ice loads, earthquakes and other potential damage causes. While Bunched cable is used for power theft control.

1.3 THESIS OF ORGANIZATION

The structure of the entire thesis organization is as following:

Chapter -1: the basic introduction about the Concept of Site project work of Transmission line installation including it’s aims, statement of purpose & thesis organization is given in short.

Chapter -2: In this chapter we describe the basic Concept of estimating and costing illustrating it’s purpose, principle, market survey essentials and the basic terminologies used for the project at work site.

Chapter -3: In this chapter the basic useful components and tools used in this survey project are described in short as per the significance of work alongwith some essentials of installation and maintenance.

Chapter -4: In this chapter the practical survey preplanning is discussed alongwith some important useful civil work such as optimizing pole location, erection, stringing, base etc.

Chapter -5: In this chapter the all required electrical preplanning is discussed followed by Indian Electricity Rules 1956 and other standard electrical specifications with respect to transmission line installation, repairing, maintenance and bunched cable replacement.

Chapter -6: In this chapter the all survey data reports are summarized and calculate to meet the expected quality of installation & replacement work taking some numerical assumptions for electrical price nearby ESR.

Chapter -7: This chapter is the valedictory of our thesis in which we wrote the final conclusion & experience at work site of our Project illustrating the important outcomes along-with the short discussion about the future scope of our presented work.

We also included a separate section for Reference & useful drawing are added as an Appendix of this thesis.

INTEGRAL UNIVERSITY, LUCKNOW

Chapter 2: BASICS OF ESTIMATING & COSTING 4-13

2.1 PURPOSE 4

2.2 PRINCIPLE 5

2.3 MARKET SERVEY& ESSENTIALS 6

2.4 BASIC TERMINOLOGIES 7

CHAPTER 2: BASICS OF ESTIMATING AND COSTING

In this chapter we describe the basic Concept of estimating and costing illustrating it's purpose, principle, market survey essentials and the basic terminologies used for the project at work site.

2.1 PURPOSE:

Estimating and costing serves the number of purposes in the construction process including preparation and finalize of bids and cost control. The main purpose is to provide to volume of work for cost control and to see that the adequate options of materials are explored during the execution of the project.

Estimation (or estimating) is the process of finding an estimate, or approximation, which is a value that is usable for some purpose even if input data may be incomplete, uncertain, or unstable. The value is nonetheless usable because it is derived from the best information available.

While the costing may be defined as the process of determining the probable cost of the installation project before the starting it in real life. Costing takes into consideration all expenditure involved in the design and installation along with all related service facilities such as Careers, Cranes, machines setting; tool making as well as a portion of sales marketing and administrative expenses or what we call overhead costs.

Thus, cost estimation simply involves a systematic and scientific approach to the future problems of the entire project work. In general, the accuracy of an estimate increases i.e. the estimated cost approximates more closely the actual production cost as more and more detailed calculations are done in estimating.

In Short, we can say that, Main purpose of estimating costs is to provide a size reference for cost control, to verify that the resources consumed during the execution of the project are kept in the costs assessed in feasibility phase of the project. Deviations from these issues can endanger the profitability of the project and a successful project can turn into a disaster. Accuracy of estimates of cost depends on existing information to reflect and their calculation.

There are several ways of classifying types of estimates of the costs of a construction project. Of these, the most significant are the followings:

a) Estimates that depend on the degree of definition of the project. Such estimates depend on the rate of breakdown of the architectural design and strength. Are defined as the level of information they have available the practitioner to perform engineering cost estimates.

b) Estimates that depend on their use. Such estimates are directly related to the utility for which they are made. Thus we have estimates used for the preparation of feasibility studies, estimates for preparing documentation authorizing the work, estimates for budget planning, estimates for the preparation of the contractors bid price, estimates for the aforementioned project, etc.

c) The methodology to estimate. To estimate costs using several methodologies, training and procedures that estimate the costs, which in turn can be probabilistic or deterministic in nature.

In the following figure 1 a schematic structure of total costs of a construction project in this regard.

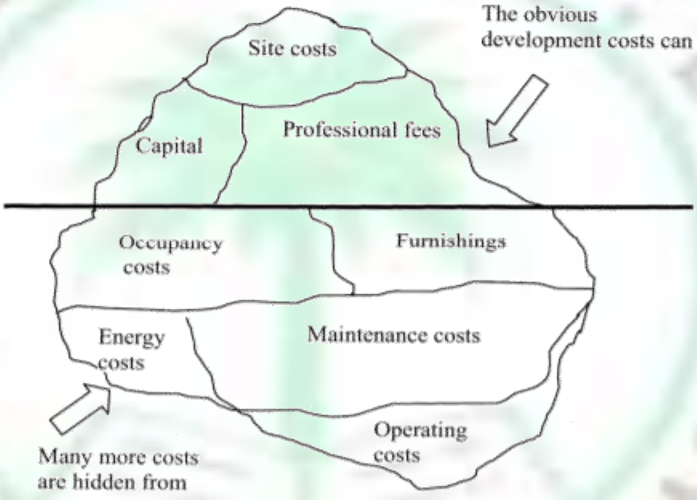


Fig. 1 – Components of life cycle costs.

2.2 PRINCIPLE:

Estimates serve a number of different functions in the industry. In the early stages of a Power Installation program, the owner needs an estimate of the probable cost of Installation, Repairing & Maintenance. This conceptual estimate has to be prepared from a minimum amount of information because it is required at a time when the project is often little more than a vague idea in the mind of the owner. Once the design of the project is underway, budget amounts can be established for the various elements of the project. When the design is completed, a final pre-bid estimate can be compiled to anticipate the contractor’s bid price for work. If this estimate is accurate, the obtained bid prices will be within the owner’s budget for the project. Most contracts that transpire in the construction industry results from competing bids from contractors to supply goods and services to meet certain specification for a stipulated sum of money. Estimates are also required after works starts on the project. In the cost control programs, estimating is required to facilitate the control of expenditure of founds on a project.

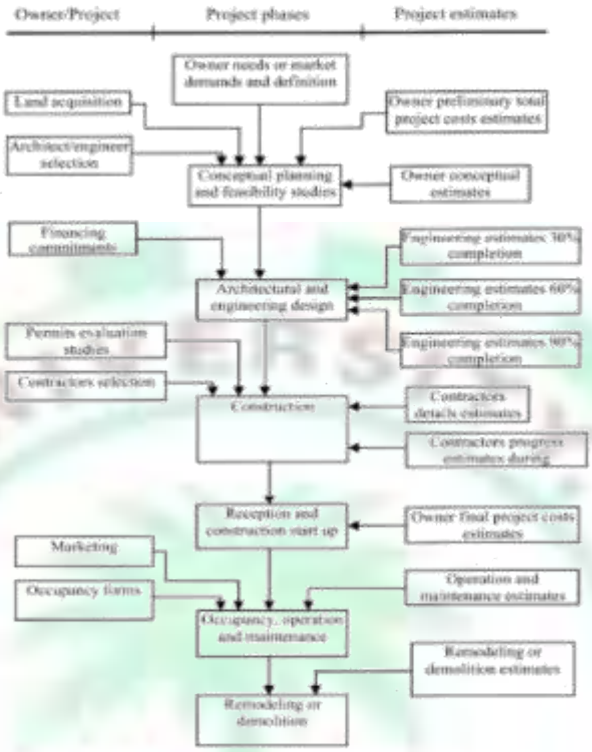

Owner/Project
Project phases
Project estimates
Owner needs or market demands and definition
Land acquisition
Owner preliminary total project costs estimates
Architect/engineer selection
Conceptual planning and feasibility studies
Owner conceptual estimates
Financing commitments
Engineering estimates 30% completion
Architectural and engineering design
Engineering estimates 60% completion
Permits evaluation studies
Engineering estimates 90% completion
Contractors selection
Construction
Contractors details estimates
Contractors progress estimates during
Reception and construction start up
Owner final project costs estimates
Marketing
Occupancy forms
Operation and maintenance estimates
Occupancy, operation and maintenance
Remodeling or demolition estimates
Remodeling or demolition

Fig. 2 – Costs estimates during construction life cycle

Estimates of materials, time, and costs provide information to some construction decisions in a similar way that financial accounting information provides to others. Financial statements are required to comply with generally accepted accounting principles, described in accounting literature, to ensure information is accurate and useful to decisions. This paper suggests general estimating principles that similarly guide good estimating practice. An estimate must be an accurate reflection of reality. An estimate should show only the level of detail that is relevant to decisions. Completeness requires that it include all items yet add nothing extra. Documentation must be in a form that can be understood, checked, verified, and corrected. Attention must be given to the distinction between direct and indirect costs and between variable and fixed costs. Contingency covers possible or unforeseen occurrences, both the expected value of possible identified events and the expectation that events will occur that cannot be identified in advance.

2.3 MARKET SURVEY & ESSENTIALS:

Market survey is an organized effort to gather information about target markets as per the requirement of the given project. Basically, it is an investigation into the state of the market for a particular list of products or service, including an analysis of consumable material needs and preferences. It is important to know about them, starting with who they are? It is a very important component of business strategy and a major factor in maintaining competitiveness of various products provided by different companies at different qualities on different costs.

Market survey is the way of getting a comparative overview of wants, needs and beliefs. It can also involve discovering how they act. The survey can be used to determine how a product could be marketed. Some experts consider market survey as market research believed to be the quintessence of marketing. Market research is a way that producers and the marketplace study the consumer and gather information about the consumers' needs. There are two major types of market research: primary research, which is sub-divided into quantitative and qualitative research, and secondary research.

The following essentials that can be investigated through market survey include:

- **Market information:** Through market information one can know the prices of different commodities in the market, as well as the supply and demand situation. Market researchers have a wider role than previously recognized by helping their clients to understand social, technical, and even legal aspects of markets.
- **Market segmentation:** Market segmentation is the division of the market or population into subgroups with similar motivations. It is widely used for segmenting on geographic differences, demographic differences technographic differences, psychographic differences, and differences in product use. For B2B segmentation firmographics is commonly used.
- **Market trends:** Market trends are the upward or downward movement of a market, during a period of time. Determining the market size may be more difficult if one is starting with a new innovation. In this case, you will have to derive the figures from the number of potential customers, or customer segments.
- **SWOT analysis:** SWOT is a written analysis of the Strengths, Weaknesses, Opportunities and Threats to a business entity. A SWOT may also be written up for the competition to understand how to develop the marketing and product mixes. SWOT method helps to determine and also reassess strategies and analyze business process
- **PEST analysis:** PEST is an analysis about external environment. It includes a complete examine of a firm's Political, Economic, Social and Technological external factors. which may impact firms objective or profitability. They may become a benefit for the firm or harm its productivity.
- **Brand health tracker:** Brand tracking is way of continuously measuring the health of a brand, both in terms of consumers’ usage of it (i.e. Brand Funnel) and what they think about it. Brand health can be measured in a number of ways, such as brand awareness, brand equity, brand usage and brand loyalty.

2.4 BASIC TERMINOLOGIES:

A

- **Allocation of costs** is the transfer of costs from one cost item to one or more other cost items.
- **Allowance -** a value in an estimate to cover the cost of known but not yet fully defined work.
- **As-sold estimate -** the estimate which matches the agreed items and price for the project scope.

B

- **Basis of estimate (BOE) -** a document which describes the scope basis, pricing basis, methods, qualifications, assumptions, inclusions, and exclusions.
- **Bill of materials (BOM) -** a list of materials required for the construction of a project or part of a project, which may include quantities.

- **Bill of quantities (BOQ) -** a document used in tendering in the construction industry in which materials, parts, and labor (and their costs) are itemized. It also (ideally) details the terms and conditions of the construction or repair contract and itemizes all work to enable a contractor to price the work for which he or she is bidding.
- **Bond -** usually refers to a performance bond, which is a surety bond issued by an insurance company or a bank to guarantee satisfactory completion of a project by a contractor. Other types of guarantees, such as a bid bond or a materials bond, are sometimes also required by a project owner.

C

- **Chart of accounts (Code of accounts) (COA) -** a created list of the accounts used by a business entity to define each class of items for which money or the equivalent is spent or received. It is used to organize the finances of the entity and to segregate expenditures, revenue, assets and liabilities in order to give interested parties a better understanding of the financial health of the entity.
- **City cost index -** Means publishes a city cost index table.
- **Construction** is a process that consists of the creation, modification, or demolition of facilities, buildings, civil and monumental works, and infrastructure.
- **Construction cost -** the total cost to construct a project. This value usually does not include the preplanning, site or right of way acquisition, or design costs, and may not include start-up and commissioning costs. This total or subtotal is usually identified as such in an estimate report. Also known as Total Estimated Contract Cost (TECC).
- **Consumables** are goods that, according to the 1913 edition of Webster's Dictionary, are capable of being consumed; that may be destroyed, dissipated, wasted, or spent (also known as consumable goods, nondurable goods, or soft goods). In construction, these may include such materials as weld rod, fasteners, tape, glue, etc.
- **Contingency -** When estimating the cost for a project, product or other item or investment, there is always uncertainty as to the precise content of all items in the estimate, how work will be performed, what work conditions will be like when the project is executed and so on. These uncertainties are risks to the project. Some refer to these risks as "known-unknowns" because the estimator is aware of them, and based on past experience, can even estimate their probable costs. The estimated costs of the known-unknowns is referred to by cost estimators as cost contingency.
- **Cost -** the value of currency required to obtain a product or service, to expend labor and use equipment and tools, or to operate a business.
- **Cost index (or factor) -** a value used to adjust the cost of from one time to another. There are various published cost indexes, listed by year, quarter, or month.
- **Costing -** the process of applying appropriate costs to the line items after the take off.
- **Pricing -** Means refers to this as, "Price the quantities." May also be called pricing.
- **Crew** – a group of people (workers) who execute a construction activity. The crew may also include construction equipment required to execute the work.
- **Crew hour (ch)** – one crew's effort for one hour of time.

D

- Deliverable is a term used in project management to describe a tangible or intangible object produced as a result of the project that is intended to be delivered to a customer (either internal or external).

- Direct costs are directly attributable to the cost object. In construction, the costs of materials, labor, equipment, etc., and all directly involved efforts or expenses for the cost object are direct costs.
- Distributables – a classification of project costs which are not associated with any specific direct account.[10]
- Duration – the amount of clock or calendar time which is required to execute a work activity or task.

E

- **Effort -** the work done in accomplishing a task or project. May be a measurement of the hours required.
- **Equipment -** a category of cost for organizing and summarizing costs, construction equipment used to execute the project work, engineered equipment such as pumps or tanks.
- **Escalation** is defined as changes in the cost or price of specific goods or services in a given economy over a period. In estimates, escalation is an allowance to provide for the anticipated escalation of costs during construction.
- **Estimation** in project management is the processes of making cost estimates using the appropriate techniques.

F

- **Facility -** an installation, contrivance, or other thing which facilitates something; a place for doing something. A building, plant, road, reservoir, etc.
- **Field Supervision (or field non-manual) -** supervisory personnel and all other non-manual staff at the construction site.
- **Foreman -** the worker or tradesman who is in charge of a construction crew. The foreman may be a hands-on worker who contributes to the work completion or a non-working foreman. A general foreman may be in charge of all or some crews.
- **Fringe Benefits -** labor cost elements which are provided to pay for benefits received by workers, such as health insurance, pension, training, etc.

G

- **General & Administrative Costs (G&A) -** the costs of operating a construction business. These costs include such things as office space, office staff, operating facilities, etc. They are not associated with any specific project, but may be allocated across projects in a cost estimate. See also Overhead, Indirect cost.
- **General contractor** is responsible for the day-to-day oversight of a construction site, management of vendors and trades, and communication of information to involved parties throughout the course of a building project.
- **General requirements -** costs for general requirements (Division 1) of the project execution which are actually part of the deliverable. Examples: project management & coordination 47, temporary facilities & controls, cleaning & waste management, commissioning.[11]

I

- **Indirect costs** are costs that are not directly accountable to a cost object (such as a particular project, facility, function or product). See also, Overhead, General & Administrative Cost, Distributable.

L

- **Labor –** a category of cost which is incurred to employ people (workers, crafts, trades, etc.) in the execution of construction work activity.
- **Labor benefits** are additional costs (such as holiday pay or health insurance) which the employer pays directly to the employee or into a fund on behalf of the employee.
- **Labor burden** is the cost of payroll taxes and insurances (such as workers' compensation) which the employer must pay to employ workers.
- **Labor rate (sometimes price) –** the amount of currency per unit of time which is required to employ people (workers, crafts, trades, etc.) in the execution of construction work activity. The rate may represent the wage rate only, or may include various benefits and labor burdens.
- Line item - one element of cost in an estimate which is listed in the estimate spreadsheet.
- **Location cost index (or factor) -** the ratio of the cost in one location to that in another location. These may include or exclude currency exchange rates. Example: 223 in Boston / 187 in Austin = 1.19. The location cost factor is used to adjust the cost from one location to another. To adjust a known cost in Austin to that in Boston, multiply the Austin cost by 1.19. See also City cost index.
- **Lump sum –** the complete in-place cost of a system, a subsystem, a particular item, or an entire project.

M

- **Man-hour (mh)** – one person's (worker, craftsman, tradesman, etc.) effort for one hour of time. Note: some attempt to make this gender neutral by renaming this as work hour or job hour or person hour, or something similar.
- **Man-hour norms -** a set of standard man-hour rates for work tasks, given normal working conditions.
- **Man-hour rate** – the amount of man-hours which are consumed executing one unit of work activity. Man-hour rate = man-hours required for work / completed work quantity. Example: Excavation 0.125 mh/cy. The man-hour rate is related to the inverse of the production rate times the number of workers in the crew performing the work. Example: Excavation at 8 cy/day (8 hour day) with 2-man crew = 2 x 8 / 8 = 2 man-hours/cy. See also Production rate. Note: some sources call this Productivity, an unnecessary confusion.
- **Mark-up** is the difference between the cost of a good or service and its selling price. A markup is added on to the total cost incurred by the producer of a good or service in order to create a profit.
- **Manual labor** is physical work done by people involved in construction the project. All of the various trade workers are included in manual labor, including foremen.
- **Means & methods -** the means and methods used in executing the work.

N

- **Non-manual labor -** work done by people who are not classified as manual labor.
- **Non-productive time -** work time which is paid but does not contribute to the production of work. Examples: safety meeting, travel time, clean up time, wash up time, etc.

O

- **Open shop** is a place of employment at which one is not required to join or financially support a union (closed shop) as a condition of hiring or continued employment. Open shop is also known as a merit shop.

- **Overhead -** In business, overhead or overhead expense refers to an ongoing expense of operating a business; it is also known as an "operating expense." See also General & Administrative Cost, Indirect Cost.
- **Overtime** is the amount of time someone works beyond normal working hours.

P

- **Per diem -** a daily allowance for expenses, a specific amount of money that an organization gives an individual per day to cover living and traveling expenses (allowance) in connection with work done away from home or on tour. (Latin for "per day" or "for each day")
- **Plug number -** a value inserted in an estimate as a place holder and an approximation of the cost for a scope element which has not been detailed yet. See also Allowance.
- **Premium pay -** the extra portion of wages paid when a worker works overtime. Example: Wage rate is 10.00/hour, overtime is paid at time and a half, or 15.00/hour, the premium pay is 5.00/hour.
- **Price** is the quantity of payment or compensation given by one party to another in return for goods or services.
- **Pricing** is the function of determining the amount of money asked in consideration for undertaking the project. Depending on the market and profit considerations, etc., the price may be more or less than the cost.
- **Production rate** – the quantity of work which is completed in one unit of time.[14] Production rate = completed work quantity / duration. Example: Excavation 8 cy/day = 1 cy/hour (in an 8 hour day). lists this as Daily Output. See also Man-hour rate. Note: some sources use the term productivity for the production rate or man-hour rate, an unnecessary confusion.
- **Productivity** is the term which relates one rate to another rate, given two differing sets of conditions for the same work. A production rate greater than the reference production rate indicates a higher productivity. A production rate less than the reference production rate indicates a lower productivity. A man-hour rate greater than the reference man-hour rate indicates a lower productivity. A man-hour rate less than the reference man-hour rate indicates a higher productivity. (The economic concept of productivity is an average measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs).)
- **Productivity factor** – the ratio of a selected production rate to a reference production rate. Example: selected rate = 102, reference rate = 80, productivity factor = 102/80 = 1.28.
- **Profit -** in accounting, is the difference between revenue and cost. In estimates, it is an allowance to provide for anticipated profit upon completion of the project.
- **Profit margin** refers to a measure of profitability. It is calculated by finding the net profit as a percentage of the revenue.
- **Project -** A temporary endeavor undertaken to create a unique product, service, or result.[17]

Q

- **Quality** can mean a high degree of excellence (“a quality product”) or a degree of excellence or the lack of it (“work of average quality”).
- **Quantify -** see: Take off
- **Quantity** is a property that can exist as a magnitude or multitude. For example 1200 mm or 10 each.
- **Quantity surveyor (QS)** is a professional working within the construction industry concerned with building costs, in the U.K. and some other areas. A QS employs standard methods of measurement to develop a bill of quantities.

R

- **Resources** are what is required to carry out a project's tasks. They can be people, equipment, facilities, materials, tools, supplies, or anything else capable of definition required for the completion of a project activity.

S

- **Schedule of values** is a detailed statement furnished by a construction contractor, builder or others outlining the portions of the contract sum. It allocates values for the various parts of the work and is also used as the basis for submitting and reviewing progress payments.
- **Scope of a project** in project management is the sum total of all of its products and their requirements or features.
- **Specification -** an explicit set of requirements to be satisfied by a material, product, or service.
- **Subcontractor** is an individual or in many cases a business that signs a contract to perform part or all of the obligations of another's contract.
- **Supplier -** A distributor or other company which supplies materials, parts, equipment, etc.

T

- **Take off -**The process of reviewing and understanding the design package and using the project scope drawings and documents to itemize the scope into line items with measured quantities. It refers to this as, "Scope out the project," and, "Quantify."
- **Task -** a distinct piece of work performed.
- **Tool -** any physical item that can be used to achieve a goal, especially if the item is not consumed in the process.

U

- **Unit cost -** the cost for one measured unit of completed work activity.

- **Unit of measure -** the term used for how a bid item is quantified.

V

- **Virtual Design and Construction (VDC)** is the use of integrated multi-disciplinary performance models of design-construction projects, including the Product (i.e., facilities), Work Processes and Organization of the design - construction - operation team in order to support explicit and public business objectives. In VDC (BIM is one method) the modeling consists of the usual three dimensions, plus the time dimension and the cost dimension.

W

- **Work** is the amount of effort applied to produce a deliverable or to accomplish a task, is everything required or supplied to complete a construction project.
- **Work breakdown structure (WBS) -** a deliverable oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.
- **Worker -** a person engaged in the accomplishment of work. In cost estimating, the hands-on workers contribute to the production and are counted in calculations of the production rate. Other workers supervise or support the hands-on work in some way.

- **Wage rate -** The agreed monetary compensation per hour for a person to accomplish work. This is the pay provided to the worker, excluding any fringe benefits or other labor burdens. Labor unions typically have negotiated agreements which define the wage rates for workers, as well as the rates for fringe benefits.

INTEGRAL UNIVERSITY, LUCKNOW

Chapter 3: BASICS OF OH TRANSMISSION SYSTEM 14-19

3.1 INTRODUCTION 14

3.2 COMPONENTS OF TRANSMISSION SYSTEM 14

3.3 INSTALLATION & MAINTENANCE 17

3.4 TOOLS USED IN TRANSMISSION SYSTEM 18

CHAPTER-3- BASICS OF OH TRANSMISSION SYSTEM

In this chapter the basic useful components and tools used in this survey project are described in short as per the significance of work alongwith some essentials of installation and maintenance.

3.1 INTRODUCTION

An Electric power transmission is the bulk movement of electrical energy from a generating site, such as a power plant, to an electrical substation. The interconnected lines which facilitate this movement are known as a transmission network. An overhead line consists of conductors and ground wires, towers, insulation, hardware, and foundations. The transmission line conductors are specialized, with large cross section and relatively few strands. Normal AC power lines use phase conductors with a central core of a few steel wires, surrounded by a sheath of many more aluminum wires wound in helixes of alternating direction. Power line conductors seem rigid when a 1-m length is handled, but over a 300-m span length, they are flexible enough to sag in a catenary between attachment points, following Bernoulli's law. The sag of the conductor varies considerably with its tension, age, loading history, and temperature.

It is always impressive to witness a modern overhead line conductor stringing operation. For example a helicopter pulls a pilot rope through a series of pulleys or travelers, attached to insulator strings. The rope is attached to a wire and pulled through the travelers using a large winch at ground level. The wire is attached to a conductor sling that can support the full pulling tension force. After the complete conductor has been pulled into travelers on several spans, it is allowed to set for a specified time, during which a permanent deformation called creep takes place. The creep relaxes the line tension and increases the sag. After some hours or days of creep, the slack is pulled out and the conductor is ready to be fixed in the insulator strings.

In short, we can say that An overhead power line is a structure used in electric power transmission and distribution to transmit electrical energy across large distances. It consists of one or more uninsulated electrical cables (commonly multiples of three for three-phase power) suspended by towers or poles.

Since most of the insulation is provided by the surrounding air, overhead power lines are generally the least costly method of power transmission for large quantities of electric energy.

3.2 COMPONENTS OF TRANSMISSION SYSTEM

Transmission Lines are made up of various components, namely poles, lattice structures, conductors, cables, insulators, foundations and earthing systems. The details of each component can't summarized here in this thesis. But as per the case requirement of this thesis only primarily components are discussed here in short as below under four major credits of it:

i. Transmission Line Structures
ii. Transmission Line Conductors
iii. Transmission Line Insulators
iv. Transmission Line Earthing

i. Transmission Line Structures

The primary functions of transmission line structures are to provide mechanical support to conductors. This is achieved by maintaining mechanical integrity without permanent structural deformation under ultimate load conditions whilst preserving structure geometry to retain operational electrical clearances under prescribed serviceability and ultimate load conditions.

Secondary functions of transmission line structures are to:

a) Ensure safety of people and the environment;

b) Maintain structure geometry to preserve maintenance-safe approach distances for serviceability and ultimate load conditions;

c) Provide an electrical path to earth for fault currents; and

d) Provide a whole-of-life cost-effective service.

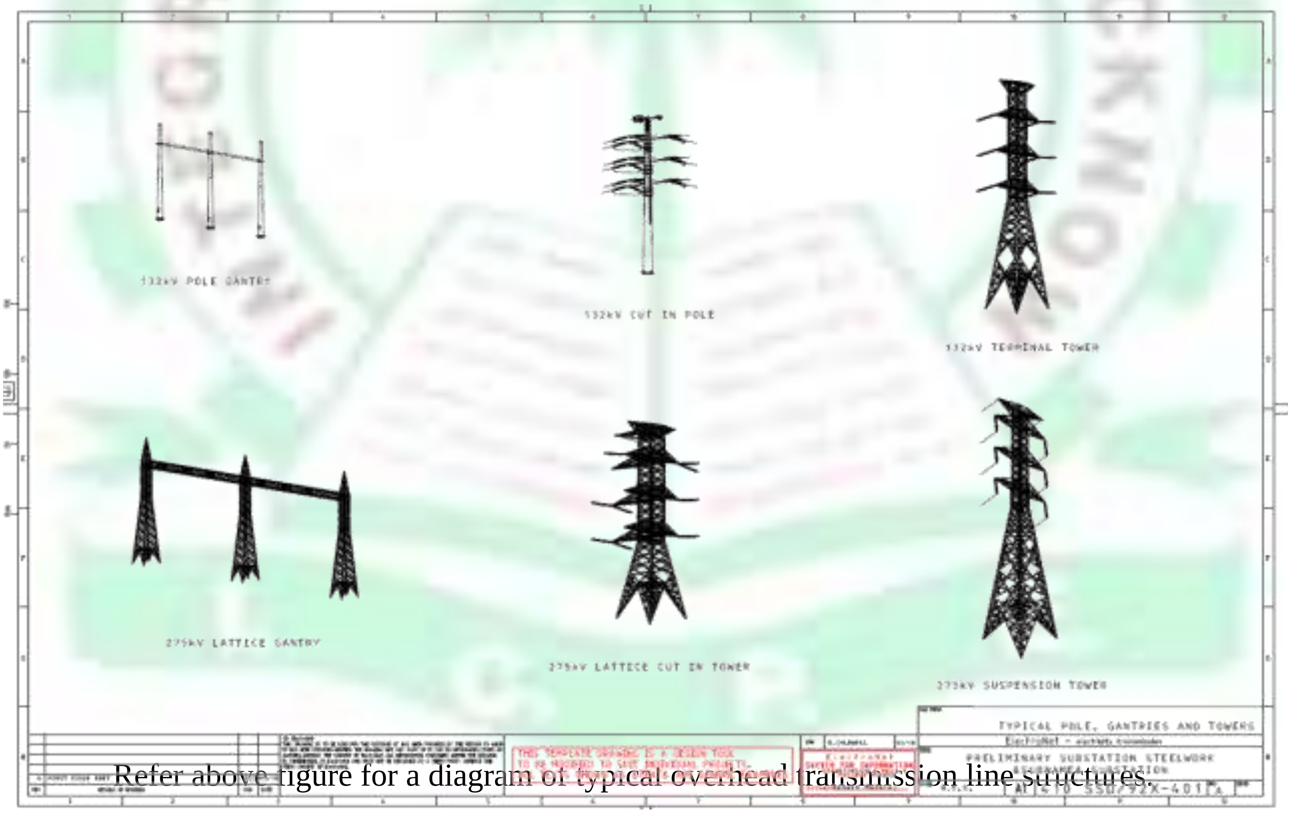
Structure types include free-standing and guyed:

a) Lattice towers / masts;

b) Steel tubular poles;

c) Stobie poles; and

d) Concrete poles.



Refer above figure for a diagram of typical overhead transmission line structures.

Typical foundations of transmission line structures are:

a) Bored piers;

b) Mass concrete;

c) Driven / cast in-situ piles;

d) Soil / rock anchors; and

e) Special Foundations (e.g. raft foundations).

ii. Transmission Line Conductors

The primary function of transmission line conductor systems is to transfer electrical power between designated locations, within prescribed performance, operating and environmental conditions.

Secondary functions of transmission line conductors are to:

a) Maintain electrical safety and minimise adverse effects on the environment; and
b) Provide a whole-of-life cost-effective service.

iii. Transmission Line Insulators

Transmission line insulation has two primary functions:
a) To insulate energised components from earthed structures at rated operating voltages and specified switching and lightning impulses; and

b) To support the conductor system up to ultimate mechanical load limits and transfer the mechanical loads to structure.

Transmission line hardware has four primary functions:
a) To support the Insulator system up to electrical load limits;

b) To support the Insulator system up to ultimate mechanical load limits;

c) To provide effective attachment interface between Conductor and Insulators to securely transfer loads to the structure; and

d) To provide a whole-of-life cost effective service.

iv. Transmission Line Earthing

The primary functional requirement of a transmission line earthing system is to:

a) Provide an electrical path for lightning and fault currents to earth, to ensure safety of people, assets and the environment.
b) Ensure that faults are cleared within the NER time limits, transmission line components are not damaged, and the network performance (due to lightning) is within agreed NER limits.
c) Provide an earth (i.e. zero) potential reference to ground under normal circuit conditions for the dissipation of leakage currents.

Secondary functional requirements of a transmission earthing system for its design life are to:

a) Maintain electrical safety and minimise adverse effects on the environment;
b) Provide an effective technical solution
c) Provide a whole-of-life cost-effective service.

Transmission Line Earthing relates to:

a) **Aerial earthing** – this sub-system includes shield-wire and OPGW and its various supporting hardware and fittings (strain assembly, suspension assembly, spark-gap insulators, vibration dampers, joints and marker balls).

b) **Ground level earthing** – this sub-system includes buried earth stakes, earth bounds PVC cable, copper strap), cable lugs, fasteners and clamps. This earthing sub-system forms a dedicated electrical connection between the structure and the soil surrounding it. This is in addition to the electrical connection provided by the embedded structure / foundation and soil.

c) **Communication hardware** – this sub-system includes the interface fibre hardware for OPGW assets. This includes fibre splice boxes, fibre termination boxes, etc.

3.3 INSTALLATION & MAINTENANCE

The basics of Transmission Line installation & maintenance covers the general overview of the steps that are necessary in the **planning and construction** of a typical overhead transmission line, to give newcomers to the trade a general format to follow, and assist transmission design engineers in understanding how such lines are built.

Stringing overhead conductors in transmission is a very specialized type of construction requiring years of experience, as well as equipment and tools that have been designed, tried, and proven to do the work. Because transmission of electrical current is normally at **higher voltages** (69 kV and above), conductors must be larger in diameter and span lengths must be longer than in normal distribution.

Although proximity to other energized lines may be limited on the right-of-way, extra care must be exercised to protect the conductor so that when energized, power loss and corona are not a problem.

Basically there are four methods that can be used to install overhead transmission conductors:

a) Slack stringing
b) Semi-tension stringing
c) Full-tension stringing
d) Helicopter stringing

a) Slack stringing

Slack stringing can only be utilized if it is not necessary to keep the conductor off of the ground, and if no energized lines lie beneath the line being strung. In this method the pulling lines are pulled out on the ground, threaded through the stringing blocks, and the conductor is pulled in with less tension than is required to keep it off the ground.

Fig: Transmission line stringing equipment

This is not considered to be an acceptable method when demands involve maximum utilization of transmission requirements.

b) Semi-tension stringing

Semi-tension stringing are merely an upgrading of slack stringing, but do not necessarily keep the conductor completely clear of the ground, or the lines used to pull.

c) Full-tension stringing

Full-tension stringing is a method of installing the conductors and overhead ground wire in which sufficient pulling capabilities on one end and tension capabilities on the other, keep the wires clear of any obstacles during the movement of the conductor from the reel to its final sag position.

This ensures that these current-carrying cables are “clipped” into the support clamps in the best possible condition, which is the ultimate goal of the work itself.

d) Helicopter stringing

Which is much more expensive per hour of work, can be much less expensive when extremely arduous terrain exists along the right-of-way and when proper pre-planning is utilized.

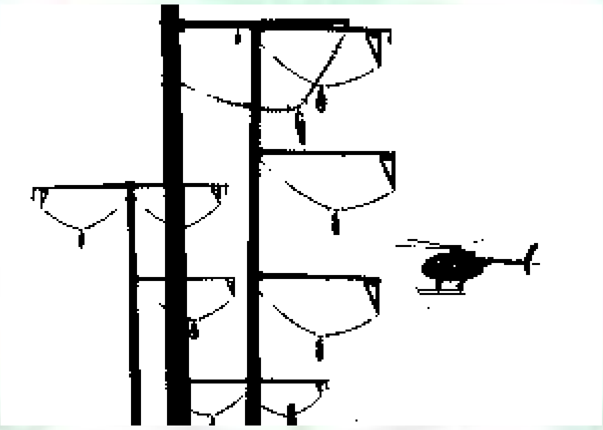


Fig: A helicopter starts the process of stringing a high-voltage transmission line

Although pulling conductors themselves with a helicopter can be done, it is limited and normally not practical. Maximum efficiency can be achieved when structures are set and pilot lines are pulled with the helicopter, and then the conductor stringing is done in a conventional manner.

3.4 TOOLS USED IN TRANSMISSION SYSTEM

Basic tools needed to construct overhead transmission lines are as follows:

1. Conductor blocks
2. Overhead ground wire blocks
3. Catch-off blocks
4. Sagging blocks
5. Pulling lines
6. Pulling grips
7. Catch-off grips
8. Swivels
9. Running boards
10. Conductor lifting hooks
11. Hold-down blocks

Conductor blocks are made in the following configurations:

- a) Single conductor
- b) Multiple conductor
- c) Multiversal type (can be converted from bundle to single, and vice versa)
- d) Helicopter

Conductor blocks should be large enough to properly accommodate the conductor and be lined with a resilient liner such as neoprene or polyurethane and constructed of lightweight, high-strength materials.

Sheaves should be mounted on anti-friction ball bearings to reduce the tension required in stringing and facilitate proper sagging. Conductor blocks are available for stringing single conductors or multiple conductors. Some are convertible, thus enhancing their versatility.
When stringing multiple conductors, it is desirable to pull all conductors with a single pulling line so that all conductors in the bundle have identical tension history. The running board makes this possible.

Pulling lines are divided into two categories:

- i. Steel cable
- ii. Synthetic rope

Torque-resistant, stranded, and swagged cable are used so that ball bearing swivels can be utilized to prevent torque buildup from being transferred to the conductor.

Some braided or woven steel cables are also used. If synthetic ropes are utilized, the most important features should include:

1. No torque
2. Very minimum elongation
3. No “kinking”
4. Easily spliced
5. High strength/small diameter
6. Excellent dielectric properties

Stringing overhead groundwires does not normally require the care of current-carrying conductors.

Chapter 4: SURVEYING AND CIVIL WORK **20-26**

4.1 PREPLANNING 20

4.2 OPTIMIZING POLE LOCATION 21

4.3 ERECTION OF POLES 21

4.4 WATER CEMENT RATIO 25

Chapter 4: SERVEYING AND CIVIL WORK

In this chapter the practical survey preplanning is discussed alongwith some important useful civil work such as optimizing pole location, erection, stringing, base etc.

4.1 PREPLANNING

The work covered by this Specification is for 33kV and 11 kV distribution lines as specified herein. Preliminary route alignment in respect of the proposed 33KV &11KV transmission lines has been fixed by the Owner subject to alteration of places due to way leave or other constraints. The Right of way shall be solved by the contractor and all expenses there of shall be borne by him. However, OWNER shall render all helps in co-ordination with law and order department for solving the same. Involvement of Forest land should be restricted as far as possible.

The detailed survey, spotting of Poles & estimating of quantities are described as a Preplanning of Civil work during the whole project:

A) Preliminary investigations have been made. The topography of all 33 kV lines and 11kV lines of more than 5 km length are enclosed in the specification as Annexures. Walk over survey, detailed survey shall have to be carried out to confirm the Route alignment by the contractor for 33 KV, 11 KV lines. If the line is passing in any Municipal/ NAC areas permission from local bodies has to be obtained prior to execution of work. Suitable distance from the side of the road has to be made towards placement of line poles.

B) Provisional quantities/numbers of different types of tower structures/Joist poles/PSC poles have been estimated and indicated in the BOQ Schedule given. However, final quantities for work shall be as determined by the successful bidder, on completion of the detail survey, preparation of route profile drawing and designing of the different types of tower structures/Joist poles/PSC poles as elaborated in the specification and scope of work.

C) The contractor shall undertake detailed survey on the basis of the tentative alignment fixed by the Owner. The said preliminary alignment may, however, change in the interest of economy to avoid forest and hazards in work. While surveying the alternative route the following points shall be taken care by the contractor.

   i. The line is as near as possible to the available roads in the area.
   ii. The route is straight and short as far as possible.
   iii. Good farming areas, religious places, forest, civil and defense installations, aerodromes, public and private premises, ponds, tanks, lakes, gardens, and plantations are avoided as far as practicable.
   iv. The line should be far away from telecommunication lines as reasonably possible. Parallelism with these lines shall be avoided as far as practicable.
   v. Crossing with permanent objects are minimum but where unavoidable preferably at right angles.
   vi. Difficult and unsafe approaches are avoided.
   vii. The survey shall be conducted along the approved alignment only.
   viii. For river crossing/ Crossing of Nallas : Taking levels at 5 meter interval on bank of river and at 20 meter interval at bed of river so far as to show the true profile of the ground and river bed railway/road bridge, road The levels shall be taken at

least 100 m. on either side of the crossing alignment. Both longitudinal and cross sectional shall be drawn preferably to a scale of 1:2000 at horizontal and 1:200 vertical.

After completing the detailed survey, the contractor shall submit the final profile and pole schedule (with no. of stay or strut) for final approval of the Owner. To facilitate checking of the alignment, suitable reference marks shall be provided. For this purpose, concrete pillars of suitable sizes shall be planted at all angle locations and suitable wooden/iron pegs shall be driven firmly at the intermediate points. The contractor shall quote his rate covering these involved jobs.

4.2 OPTIMISING POLE LOCATION

The Optimizing pole location is preparation for Erection of poles. The traditional methods are widely adopted to calculate average span length between the two adjacent poles. In this section we are going to discuss the four important cases of optimizing pole location as below:

a) Pole Spotting:

To optimize the line length, the contractor shall spot the poles in such a way so that the line is as close as possible to the straight line drawn between the start & end point of the line.

b) Road Crossings:

At all road crossings, the 13mtr GI RS Joist single pole shall be used. There should absolutely no joints in the conductors in all road, power line and all other major crossing. The ground clearance from the road surfaces under maximum sag condition shall be not less than 8.5mtr over roads. In National High way the minimum height of guarding at the maximum sagging point should be less than 8.5 mts.

c) Railway Crossings:

The railway crossing shall be carried out with underground cables in the manner as approved & prescribed by the railway authorities from time to time, preferably by HDD method using HDPE pipes. During detailed engineering, the contractor shall prepare & submit the proposed arrangement for each railway crossing to the owner along-with all documents drawings etc as per the requirements The approval for crossing railway track shall be obtained by the owner from the Railway Authority.

d) Power Line Crossings:

Where the line is to cross over another line of the same voltage or lower voltage, provisions to prevent the possibility of their coming into contact with each shall be made in accordance with the Indian Electricity Rules.

4.3 ERECTION OF POLES

The Contractor shall erect structures in accordance with the detailed design information shown on the drawings and the manufacturers recommendations

Poles shall not be modified, on site by the contractor without prior approval from the Superintendent. Any drilling of poles should be done under the direction of the

Superintendent and the pole manufacturer. Pole structures shall be erected so that the deviation from the vertical of the pole top shall not exceed 1/100th part of the overall height of the pole above ground except for the angle/termination poles without top stays and unstayed flying angle poles which shall be raked back by the calculated (or test) serviceability load deflection.

Poles shall be located to within 50 mm of the pegged pole position and centralised in holes with a minimum clearance of 150 mm between the pole and the edge of the hole for the total buried length. Suspension type insulator strings that are supported by a crossarm may be attached to the crossarm before the structure is erected. These insulator strings shall be securely tied to the crossarms prior to pole erection to prevent insulator damage. Ladders and ladder stiles shall be erected straight to within ±10 mm of bow. Stayed poles shall have all stays connected to them and anchored securely as soon as the poles are stood. Stay wires on poles with counterbalancing (opposing) stays shall be pretensioned to 5 - 10 kN. Care shall be exercised in the application of load and sequence of loading of stays so that erection stresses are not built into the structure

The pole's resp. tower's foundation is of utmost importance for the stability of overhead-line poles resp. towers.

For poles of wood or reinforced concrete no special foundations are required. However, for giving the concrete mast or steel tower increased stability, e.g. as anchor tower, the base of the tower may be concreted. This holds for wooden poles' concrete pole butts too.

Note: Concreting of wooden poles is not permitted!

According to the pegged out route of the overhead line pits for the poles are dug or holes are drilled. Wherever possible the work is to be done by machines.

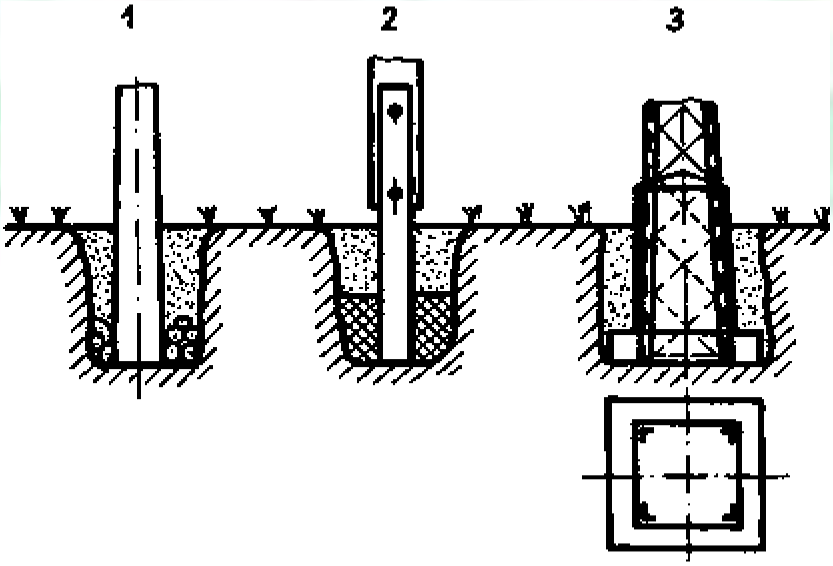


Fig: Foundations of poles

i. Pole without special foundation
ii. Concreted pole footing of a wooden pole
iii. Concreted foundation for a steel tower

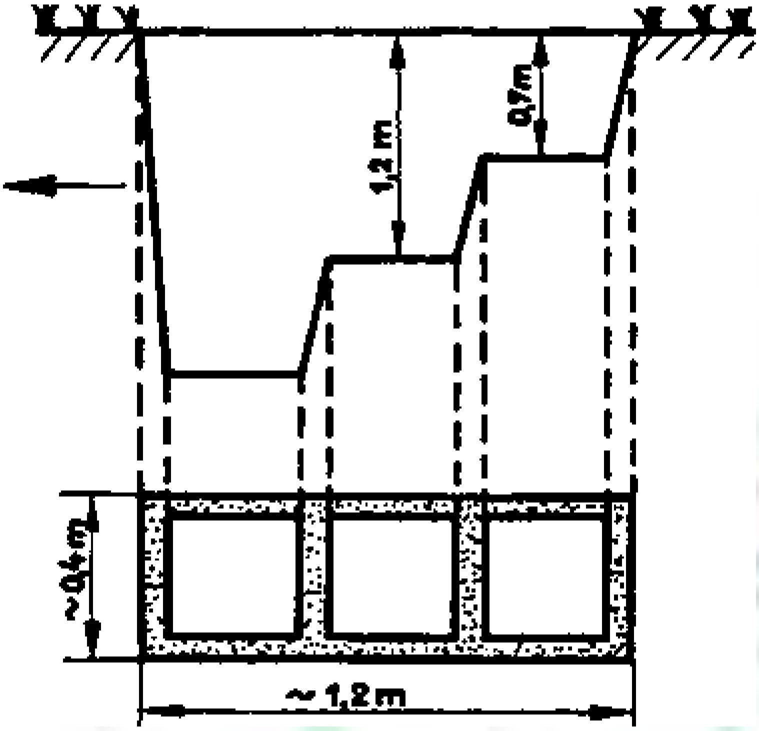


Fig:. Pits for poles without special foundation.

Note: The base of the pole's pit must at least have the diameter of the pole!

Prior to excavating the pole's pit the corner points are to be pegged out. The excavated soil stays beside the pit of the pole serving for back-filling of the remaining hole after erection of the pole. Prior to erecting the poles the insulators are screwed to the pole resp. bolted to the cross arms. These cross arm are bolted with the insulators as per requirement.

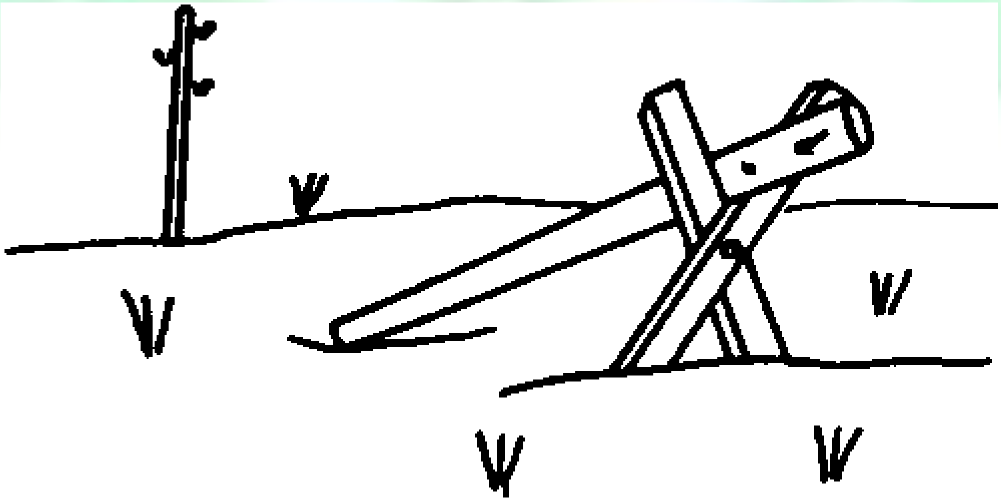


Fig: Putting a pole on a forked trestle

For mounting insulators to the pole, application of a forked trestle is being recommended.

When mounting insulators to a wooden pole the distances according to fig. 2.9. are to be adhered to.

In steel resp. concrete towers the mounting holes for the insulators will have already be provided by the maker.

If in difficult territory it will be impossible to put up the poles by means of truck-mounted crane the poles may be erected aided by wooden rods being bound together in the shape of shears. For easing sliding of the poles into their pit, a sliding board or plank is placed vertically to the front wall of the pole's pit. The vertical position of the pole is to be checked by means of a plummet or other measuring device.

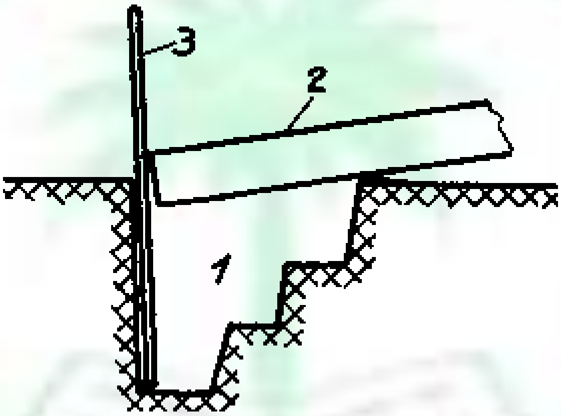


Fig.. Pole's pit with sliding plank
1 pole's pit, 2 pole, 3 sliding plank

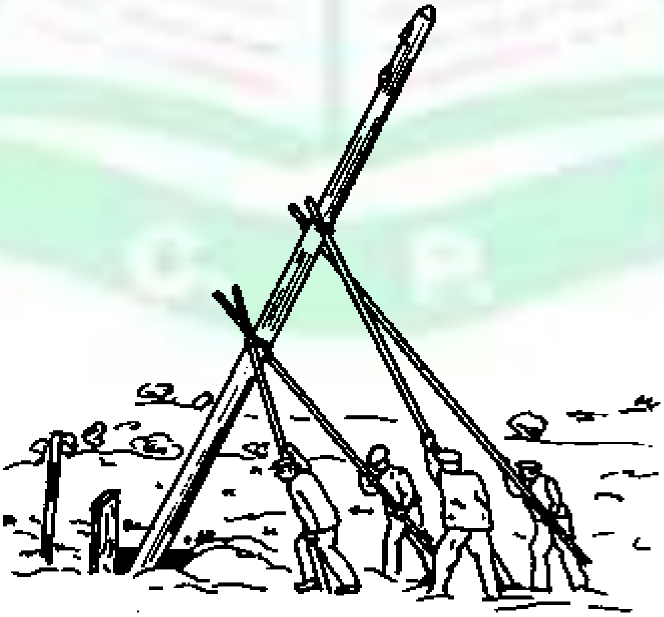


Fig. Erecting of a wooden pole

The hollow spaces in the pole's pit surrounding the pole are to be back-filled with soil and stones. The soil is to be stamped for giving good stability to the pole.

4.2 WATER CEMENT RATIO

Concrete shall be either ordinary or controlled and in grades designated M10, M15, M20 and M25 as specified in IS: 456 (latest edition). In addition, nominal mixes of 1:3: 6 and 1: 4: 8 of nominal size 40 mm maximum, or as indicated on drawings, or any other mix without any strength requirements as per mix design shall be used where specified.

Ordinary concrete shall be used for all plain cement concrete work and where shown on drawings or allowed by the Engg In-charge. Ordinary concrete shall not require preparation of trial mixes.

In proportioning concrete, the minimum quantity of cement shall be as specified in of this clause and the amount to be used shall be determined by actual weight. The quantities of fine and coarse aggregate may be determined by volume, but preferably by weight.

The water cement ratio shall not be more than those specified in IS 456.

Grade of Concrete	Minimum cement content per c.m. of finished concrete (in Kg)
M 10	236
M 15	310
M 20	400

As a guide to perform the mix design properly, the relationship between water cement ratio, aggregate to cement ratio, workability and strength of concrete will be as per relevant IS. The cement /total aggregate ratio is not to be increased beyond 1: 9.0 without specific permission of the Engg In-charge . It should be noted that such high aggregate/cement ratios will be required for concretes of very low slump and high water cement ratios which may be required to be used in mass concrete work only. The actual cement aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used, and from trial mixes.

The mix proportions for all grades of concrete shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than the value given below:

Grade Designation	Characteristic Compressive Strength at 28 days
M 10	10 N / sq. mm
M 15	15 N / sq. mm
M 20	20 N / sq. mm

The strength of concrete given above is the 28 days characteristic compressive strength of 15 cm cube. The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete. When fresh concrete is required to be placed on previously placed and hardened concrete, special care should be taken to clean the surface of all foreign matter. For securing a good bond and water tight joint, the receiving surface should be made rough and a rich mortar placed on it unless it has been poured just before.

The mortar layer should be about 15 mm thick with cement and sand proportion as that of the mix in use, and have the same water-cement ratio as the concrete to be placed. After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men and over vibration shall not be permitted. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there is any sign of washing of cement and sand, the concrete shall be entirely removed immediately. Slabs, beams and similar structure shall be poured in one operation normally. In special circumstances with the approval of Engg In-charge these can be poured in horizontal layers not exceeding 50 cm. in depth. When poured in layers, it must be ensured that the under layer is not hardened. Bleeding of under layer if any shall be effectively removed. 10.11 Compaction.

Chapter 5: IE RULES AND PREPLANNING 27-37

5.1 PREPLANNING 27

5.2 FOR POWER TRANSMISSION LINES 31

5.3 FOR REPAIRING & MAINTAINANCE 32

5.4 FOR BUNCHED CABLE REPLACEMENT 32

CHAPTER 5 IE RULES AND PREPLANNING

This chapter is the valedictory of our project thesis in which we wrote the final conclusion of our Project illustrating the result along-with the short discussion about the future scope of our presented model.

5.1 PREPLANNING:

The preplanning is very important step before proceeding towards stinging, sagging and clearance setting. For this Indian Electricity rules pertaining to transmission line, its sagging & also its future repairing/replacement & Maintenance pertaining to clearance, stringing & sagging, are given as under the Indian electricity rules.

Installation of conductors can be commenced only after the poles have been placed and Indian Electricity Rule 1956, Clause No 77, mentions, the minimum distance between bottom conductor and ground of different overhead transmission lines. For example, the minimum distance between bottom conductor and ground of a 400KV transmission line is 8.84 meter.

Similarly, the other rules are written inside this under various class nos in it.

Also, for safety measures under any commissioning project of a transmission line it is important to fetch some points here from Indian Electricity Rule 1957.

So, by combining both aforesaid things we are going to discuss few valuable & Important Indian Electricity Rules (IE-1956 & IE-1957).

As an Electrical Engineer, it is very essential to follow the safety precaution while carry out the electrical installations and commissioning work so some of the Important Indian Electricity Rules are given below.

India Electricity Rule No.-54

A supplier shall not permit the voltage at the point of commencement of supply to vary from the declared voltage.

a) In case of low & medium voltage, the variation not more than by 6%.

b) In case of High voltage by 6% in the higher side and 9% in lower side.

c) In case of Extra high voltage by 10% in the higher side and 12.5% in lower side.

India Electricity Rule No.-55

Declared frequency of A.C supply to consumer to vary from the declared frequency by more than 3%.

India Electricity Rule No.-56

Stipulates that the supplier may affix one or more seals to meters and cutouts and no person other than the supplier shall break any such seal.

India Electricity Rule No.-57
Stipulates the provision to ensure correctness of meters, maximum demand indicators and other apparatus on consumers premises.

India Electricity Rule No.-58
It states the point of commencement of supply" The point of commencement of supply of an energy to a consumer shall be deemed to be the point at the incoming terminal of cutouts installed by the consumer under rule no.50.

India Electricity Rule No.-59
Provides precautions to be taken against failure of supply and notice of failures to be given.

India Electricity Rule No.-76
Stipulates maximum stresses "factor of safety"
a) for metal supports= 1.5

b) for mechanically processed concrete support= 2.0

c) for hand moulded concrete support= 2.5

d) for wood support= 3.0

e) minimum factor of safety for stay wires, ground wires or bearer wires shall be= 2.5

f) minimum factor of safety for conductor= 2.0
Safety Factor = (Ultimate Stress/ Actual Stress)

India Electricity Rule No.-77
Minimum ground clearances as per IE- 1956
Voltage in kV to ground in Metre
132 6.10

220 7.0

400 8.84

800 12.40

Overhead lines along the street (parallel to the street) & across the street/ road

Voltage Level	Ground clearances in meter(along the street)	Ground clearances in meter(across the street)
Low and Medium Voltage	5.5	5.8
High Voltage	5.8	6.1
Extra High Voltage	5.8 + add 0.3 meter for every additional 33 kV	6.1 + add 0.3 meter for every additional 33 kV

Overhead lines without across or along the street/ road

Voltage Level in kV	Ground clearances in meter
Low/medium/HT Line up to 11 kV, if bare conductor	4.6
Low/medium/HT Line up to 11 kV, if insulated conductor	4.0
Above 11 kV Line	5.2
Above 33 kV Line	5.8 + add 0.3 meter for every additional 33 kV

India Electricity Rule No.-78

Clearances between Trolley/Tram and Conductors

Voltage level in kV	Clearances in meter
Low and Medium voltage	1.2
High Voltage up to 11 kV	1.8
High Voltage above 11 kV	2.5
Extra High Voltage line	3.0

India Electricity Rule No.-79

Clearances for roof, open balcony, Verandah roof and lean to roof

Line passes through	**Clearances in meter**
Line passes over building vertical clearances	2.5
Line passes adjustments of buildings horizontal clearances	1.2
For pitched roof	
Line passes over building vertical clearances	2.5
Line passes adjustments of buildings horizontal clearances	1.2

India Electricity Rule No.-85

Stipulates maximum interval between supports, all conductor shall be attached to supports at intervals not exceeding the safe limit based on ultimate tensile strength of the conductor and the factor of safety prescribed in Rule No.-76.

India Electricity Rule No.-87

Minimum clearances between line crossing each other (IE 1957)

System Voltage in kV	**11-66 kV**	**132kV**	**220kV**	**400kV**	**800kV**
Low and Medium	2.44	3.05	4.58	5.49	7.94
11-66	2.44	3.05	4.58	5.49	7.94
132	3.05	3.05	4.58	5.49	7.94
220	4.58	4.58	4.58	5.49	7.94
400	5.49	5.49	5.49	5.49	7.94
800	–	7.94	7.94	7.94	7.94

Minimum Height above railway as per IE-195

Voltage level	**Broad meter & narrow gauge**
Above 66 kV up to 132 kV	14.60
Above 132 kV up to 220 kV	15.40
Above 220 kV up to 400 kV	17.90
Above 400 kV up to 500 kV	19.30
Above 500 kV up to 800 kV	23.40

5.2 FOR POWER TRANSMISSION LINES:

- Nobody should climb any tower carrying live overhead conductors.

- Cows or other domestic animals should not be tied with any tower legs and stay wires.

- Nobody should be allowed to throw any metallic strip, metallic wire, ropes and green twinges to the live overhead lines.

- If any conductor is snapped or dangling from the tower, should not be touched without proper shutdown and temporary earthing arrangement. In this case nobody should be allowed to come closer to the snapped or hanged conductor until the entire circuit is isolated and earthed from both ends of substations. In additions to that the snapped conductors should also be locally temporarily earthed with proper earthing rod before touching it for repairing work.

- If we see any sparking on the live conducting parts of overhead system, we should immediately inform to the concerned authority.

- We should not put any temporary or permanent bands or embankments under the live overhead line which is causes reduction in ground clearance of the Overhead line.

- We should not carry any long metallic poles, bamboos, pipes etc below the live conductors. Farming just below the overhead electrical lines are allowed but cultivation of sugarcanes like plants h be avoided if those grow above 5 meters height.

- Over loaded bullock carts, tractors trail or similar kind of vehicle with height more than 5 meters from ground level should not cross any live overhead lines.

- Any building either temporary or permanent should not be constructed below the overhead line. Not only below the overhead lines, the building should also be constructed well away from the line by following standard electrical clearance rules of the country.

- We should not touch any overhead tower body during rain.

- We should keep sufficient safe distance from the overhead line during stormy weather. During storm, any line conductor or tower may accidentally fall on us.

5.3 FOR REPAIRING & MAINTENANCE:

This section covers information about the health diagnostic methods, as well as about preventive and predictive maintenance techniques in cold line and in hot line conditions Maintenance of transmission lines. The transmission lines play a very important role in transmitting the huge quantum of electrical power generated at various generating stations to the whole area of the country from one end to other end over a distance of several hundreds of kilometers. By such transmission it is possible to distribute the power to the various types of customers through substations, at lowest possible line losses.

For uninterrupted power supply it is essential to maintain the transmission lines in trim and healthy condition.

(1) Save as provided in Section 13, sub-section (3), nothing in this Part shall be deemed to authorize or empower a licensee to place any overhead line along or across any street, railway, tramway, canal or waterway unless and until the State Government has communicated to him a general approval in writing of the methods of construction which he proposes to adopt: Provided that the communication of such approval shall in no way relieve the licensee of his obligations with respect to any other consent required by or under this Act.

(2) Where any overhead line has been placed or maintained by a licensee in breach of the provisions of sub-section (1), the State Government may require the licensee forthwith to remove the same, or may cause the same to be removed, and recover from the licensee the expenses incurred in such removal.

(3) Where any tree standing or laying near an overhead line or where any structure or other object which has been placed or has fallen near all overhead line subsequently to the placing of such line, interrupts or interferes with, or is likely to interrupt or interfere with, the conveyance or transmission of energy or the accessibility of any works a Magistrate of the first class or, in a presidency-town [the Commissioner of Police, may, on the application of the licensee,, cause the tree, structure or object to be removed or otherwise dealt with as he thinks fit.

(4) When disposing of an application under subsection (3), the Magistrate or Commissioner of Police, as the case may be, shall, in the case of any tree in existence before the placing of the overhead line, award to the person interested in the tree such compensation as he thinks reasonable, and such person may recover the same from the licensee.

5.4 FOR BUNCHED CABLE REPLACEMENT:

Installation of conductors can be commenced only after the poles have been placed and completely mounted. The foundations must be hardened and ropes resp. ties be ready.

As a rule, the stranded conductors are supplied on drums to the erection site, or in case of small cross sections and quantities in coils and pulled off the reel.

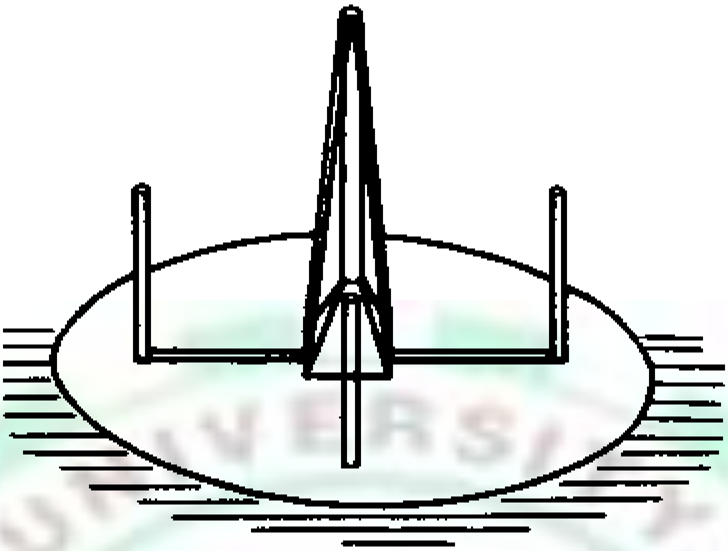


Fig. Reel

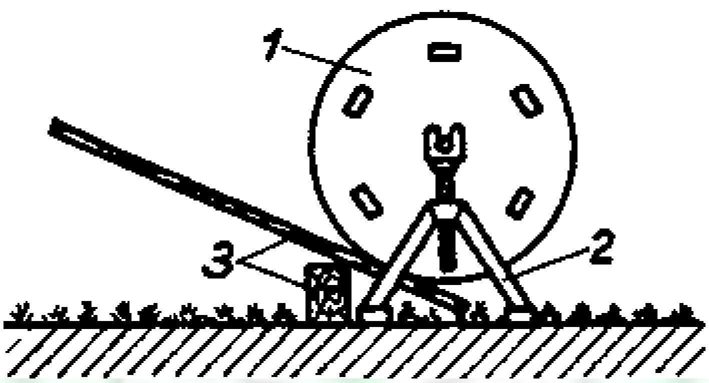


Fig. Jacked up rope drum with leverage brake

1. Rope drum,
2. Adjustable jack,
3. Leverage brake

INTEGRAL UNIVERSITY, LUCKNOW

The rope drums are being jacked up, and the stranded conductors are pulled off the drum.

For jacking up the rope drums jacks being adjustable in height and a solid steel axle are being employed. For better rotation of the drum on the axle the axle is well greased at both bearing points of the drum. The jacks are put up as high as to have the drum placed in exactly horizontal position (some centimeters above the ground).

For pulling the stranded conductors off, two methods are applicable:

- laying the stranded conductors on the ground,
- pulling the stranded conductors off, clear of the ground.

Stranded conductors of steel or copper may be dragged over the ground, while for stranded conductors the outer layers of which consist of aluminium this is not permitted. The stranded conductors could be damaged thereby.

Small cross sections are pulled off manually. In long-distance stringing systems fish ropes and rope winches are employed. When paying out the stranded conductors on the ground, care will have to be taken to avoid damage to the stranded conductors by pointed objects like stones, barbed wire etc.

When pulling off clear of the ground the stranded conductors will be guided via pulleys.

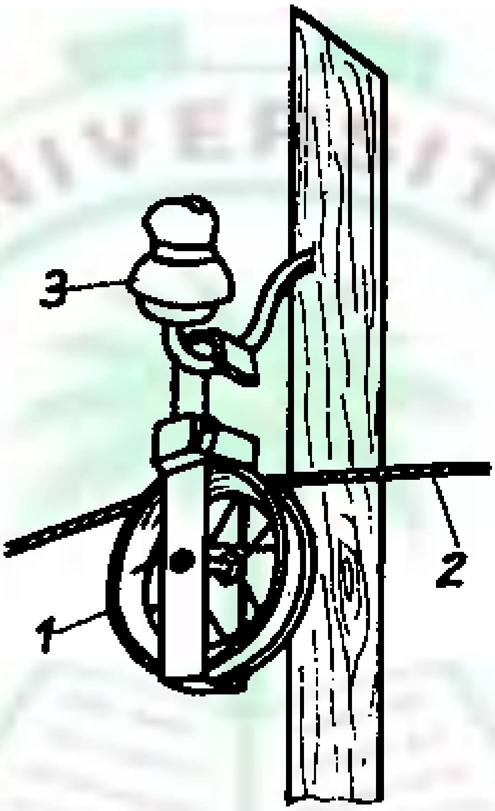


Fig: Suspended rope pulley at pole

1. Rope pulley, 2. Rope, 3. Insulator

At crossings of streets, roads or other traffic lanes the stranded conductors are under all circumstances to be protected against damage. Simple horses are used in this case over which the stranded conductors are being laid.

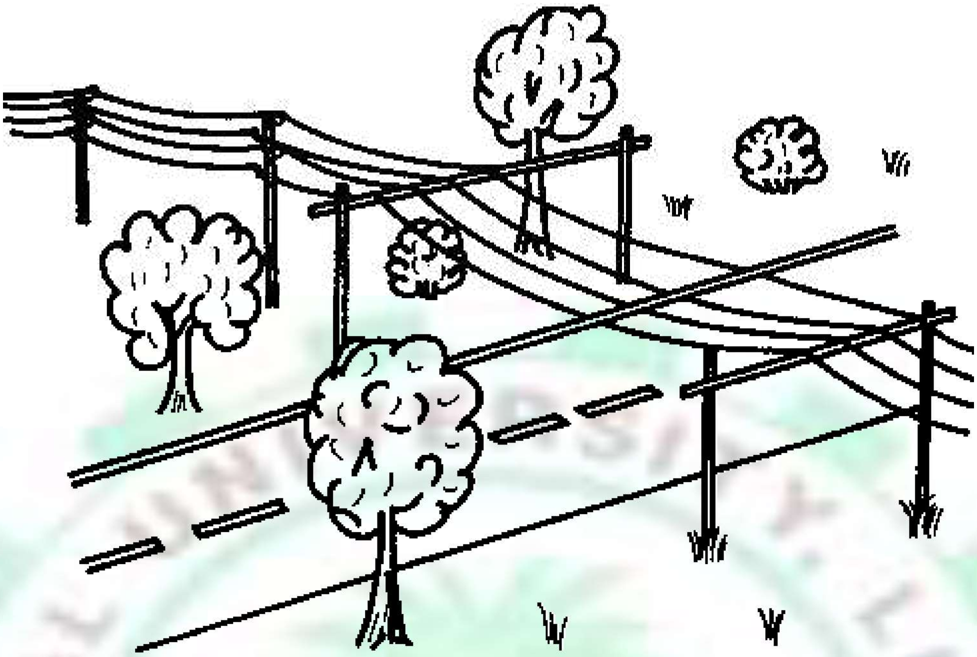


Fig. Sliding horse at a roadside

After the stranded conductor has been run out, one end is fixed to the insulator or pole.

For adjusting the sag, the stranded conductor is pulled back in direction of the rope drum.

Prior to adjusting the sag all temporary conductor joints are to be disassembled and to be replaced by proper conductor joints!

For pulling back the stranded conductors special draw-vices are employed which do not damage the stranded conductors' surface. In particular this is important for aluminium conductors.

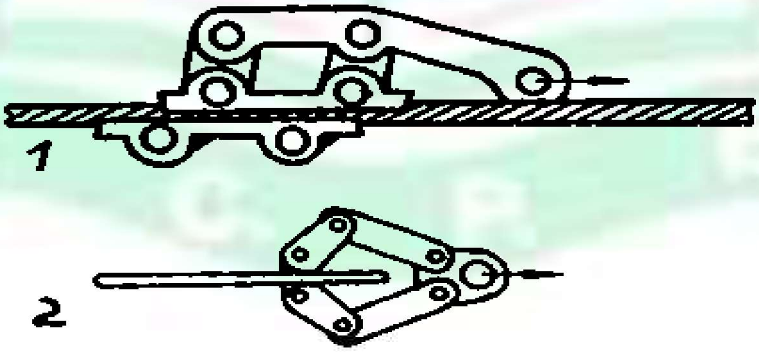


Fig. Draw vices

---

1. *Draw vice for stranded aluminium conductors*
2. *Draw vice for stranded copper conductor*

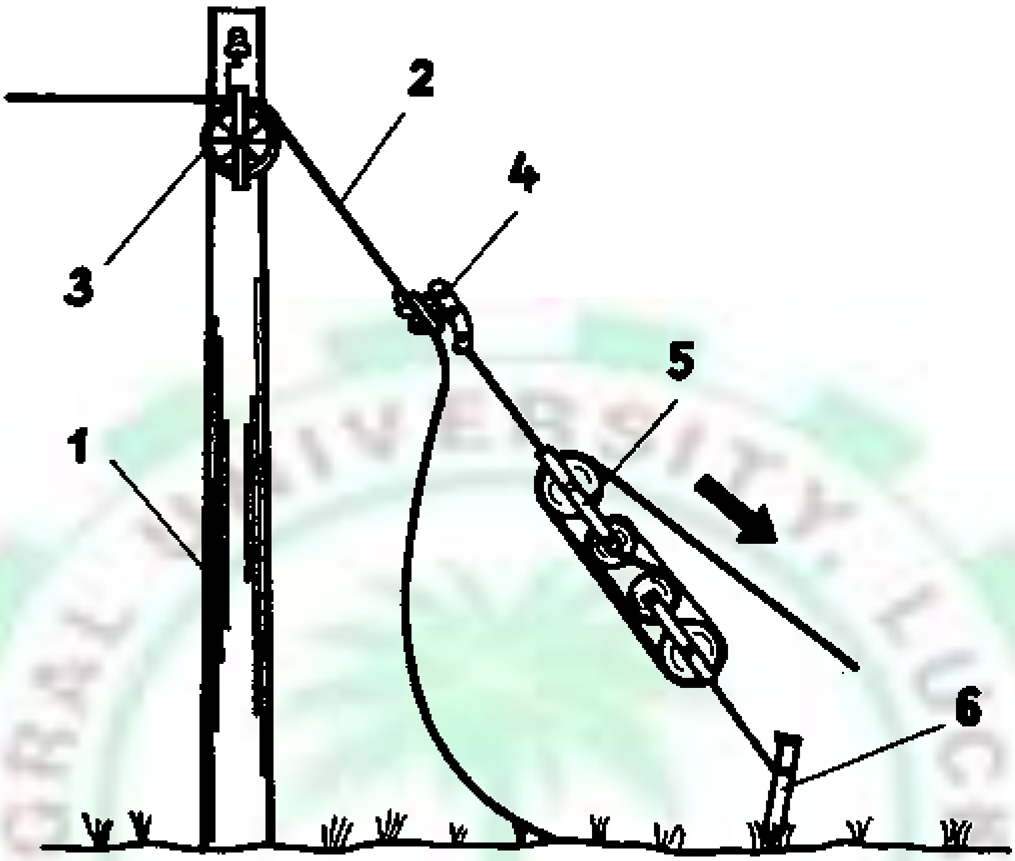


Fig: Tensioning the stranded conductor

1. Pole,
2. Stranded conductor,
3. Rope pulley,
4. Draw vice,
5. Pulley,
6. Anchorage

The permissible sag is to be taken from corresponding tables. By slow slackening the stranded conductor the sag is created. In case of long spans the stranded conductor will be sagging more than in case of short ones.

The sag to be adjusted will depend on the distance between support points (span), on the cross section and material of the stranded conductor and on the temperature!

Adherence to the sag may be checked optically by simple auxiliaries.

INTEGRAL UNIVERSITY, LUCKNOW

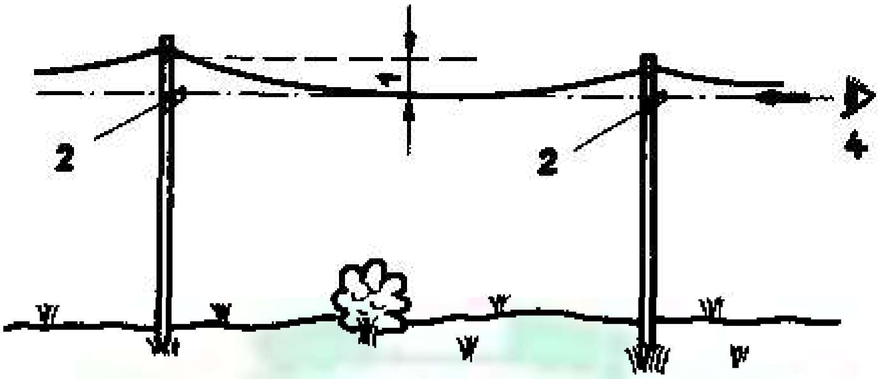


Fig: Checking the sag of the stranded conductor

1. Sag,
2. Adjusting batten,
3. Line of sight,
4. Eye.

Table 2.3. **Technical data of simple wooden poles with stranded copper conductors**

conductor cross section	span	length of pole	dig-in depth	sag at + 40°C
mm	m	m	m	m
25	35	9	1,6	0,43
	40			0,51
	45			0,64
	50			0,78
	55			0,94
	60			1,12
	65			1,28
	70			1,48
35	35	9	1,6	0,50
	40			0,62
	45			0,76
	50			0,91
	55			1,07
	60			1,25
	65			1,44
50	35	10	1,8	0,55
	40			0,67
	45			0,82
	50			0,96

Chapter 6: AREA WISE INSPECTION & SERVEY DATA 38-42

3.1 INTRODUCTION 38

3.2 AREA WISE REPORTS 39

3.3 CALCULATIONS 41

CHAPTER 6: AREA WISE INSPECTION & DATA SERVEY

This chapter describes the core calculation for cost estimation in our project illustrating the cost analysis and important calculation with material list.

6.1 INTRODUCTION:

Area wise analysis on the given overhead transmission line on property values has expanded over the past two years as a security check the smooth running of electricity on it and more detailed examination over the complete project commissioned or ready for commissioning. Conclusions as a result of these studies have varied widely to report higher authorities, with some engineers reporting no effects, others finding small effects, and still others reporting quite large effects. Also the purpose of this survey is to review and summarize the progress report over the past two years, to assess the knowledge gained from recent research, and to suggest directions for future studies.

Results from the literature survey on various reports of it during the past consecutive years at different phases of work. further suggest that the market value of residential property can be affected by proximity to high voltage power lines. Majority of the findings of previous studies, from 2018 to 2020 conclude that property value effects due to high-voltage overhead transmission lines cannot be presumed and are generally infrequent. Further research is needed which would compare the growth in property prices of sales transactions both before and after the period of HVOTL provision. In addition previous studies had been limited to a specific case study region. Further case studies using hedonic price model techniques could measure differences in possible spatial or environmental effects of various neighbouring suburbs. Future research should equally seek to provide quantitative measures of the value impact as a function of the variable identified by survey participants

6.2 AREA WISE REPORTS:

Transmission Lines (11 kV) Commissioned/Ready for commissioning During Jun-2020

As on 30-Jun-2020

Sl. No.	Voltage Level (kV)	Name of Transmission Lines	Circuit Type	Executing Agency	Line Length (cKM)
1.	**2.**	**3.**	**4.**	**5.**	**6.**
CENTRAL SECTOR Sector					
1	220	Charging of Fareedpur - Navalpur Line (2nd Ckt.)	DCDS	PGCIL	1
Total of CENTRAL SECTOR					**1**
Sub-feeder SECTOR Sector					
2	11	LILO of 11 kV Navalpur - Sitarganj at Betul (PGCIL)	A/C	MPPTCL	78
3	11	LILO of 2nd Ckt. of PGCIL Jalandhar - Kotla Jangan (nakodar) line at Kartarpur	A/C	Pvt Contractor	1
4	11	LILO of both ckt. Osar - Radhauli at Kurd (LILO from loc.No. 211) S/s (GEC-I)	A/C	MPPTCL	56
5	11	LILO of one Ckt. of 11kV KTS-Lower Navadawan-I line - 400/220kV Osar S/S	A/C	UPPTCL	1
6	11	LILO of Rajanpur - Osar 220kV line at Jaora (2nd Ckt.)	A/C	UPPTCL	4
7	11	LILO of Maini - Chondra TPSat Takhatpur	A/C	UPPTCL	88
8	11	PGCIL Dadhaulli - Navadavan	A/C	UPPTCL	13
9	11	Takhatpur - Radhauli (Kalan) line	A/C	UPPTCL	150
Total of STATE SECTOR					**391**
Grand Total					**392**

Transmission Lines Completed During FY- 2020-21

As on 30-Jun-2020

Voltage Level (kV)	Name of Transmission Lines	Circuit Type	Executing Agency	Line Length (cKM)	Month of Completion
1.	**2.**	**3.**	**4.**	**5.**	**6.**
765 kV					
CENTRAL SECTOR					
1	Tehri Pooling Station - Bareilly (Remaining part)	S/C	UPPTCL	1	APR-20
2	Charging of Tehri Pooling - Bareilly line (2nd Ckt.)	S/C	UPPTCL	1	JUN-20
Total of CENTRAL SECTOR				**2**	
Total of 400 kV				**2**	
400 kV					
CENTRAL SECTOR					
3	Bareilly - Faridpur line (Ckt.-II)	D/C	UPPTCL	206	APR-20
4	Radhauli (Kalan) - Navadhavan line (2nd Ckt.) - Rural Portion	D/C	UPPTCL	172	MAY-20
Total of CENTRAL SECTOR				**378**	
Total of 400 kV				**378**	
220 kV					
STATE SECTOR					
5	Navadavan - Maini line	S/C	TANTRANSCO	77	APR-20
Total of STATE SECTOR				**77**	
Total of 230 kV				**77**	
11 kV					
STATE SECTOR					
6	Takhatpur- Maini	A/C	UPPTCL	83	APR-20
7	Brahampur Kundan - Shahpur	A/C	UPPTCL	142	APR-20
8	LILO of one Ckt. of Bhopal - Hoshangabad at Adampur	A/C	UPPTCL	6	MAY-20
9	LILO of Meramundali - Duburi Ckt-I at Goda	A/C	UPPTCL	12	MAY-20
10	PGCIL Shahpur - Magnadpur	A/C	UPPTCL	13	JUN-20
11	LILO of 220 kV Sarni - Pandhurna line at Betul (PGCIL)	A/C	MPPTCL	78	JUN-20
12	LILO of both ckt. Osar - Dandolli at Sisayya (LILO from loc.No. 211) S/s (GEC-I)	DCDS	MPPTCL	56	JUN-20
13	LILO of Sisaiyya – Sisayya Maganpur 220kV line at Jaora (2nd Ckt.)	D/C	MPPTCL	4	JUN-20
14	LILO of 2nd Ckt. of PGCIL Navadvan – Karanpur Kalan line	D/C	UPPTCL	1	JUN-20
15	Rudrapur (Brahmwari) - Ghansali line	D/C	UPPTCL	150	JUN-20
16	LILO of one Ckt. of 220kV KTS-Lower Navadia sahora -I line - 400/220kV takhatpurS/S	D/C	TSTRANSCO	1	JUN-20

17	LILO of Sikandararao - Jawaharpur TPSat Kashganj	D/C	UPPTCL	88	JUN-20
Total of STATE SECTOR				**634**	
Total of 11 kV				**634**	
Grand Total				**1091**	

6.3 CALCULATIONS:

Case I: An overhead Line of 11 KV 50Hz has to be erected using 10 meter long RCC Poles and ACSR Conductor 6/1 x 2.59 mm with the average span of 100 mt make a list of material required and estimate the cost per km of line.

V_L= 11KV 3-phase 50Hz

Length of RCC Pole = 10 mt

ACSR Conductor = 6/1 x 2.59 mm

Length of 11KV Line = 100 mt

Avg Span of Line = 100 mt

No. of Spans = 1000/10 = 10 Nos
No. of Poles = 10+1 = 11 Nos
Here first and last poles will be double poles.
So total No of Poles = 11+2 = 13 Nos
No of Conductor = 3 Nos
Length of Line Conductor = 3x1000 + 2% = 3000+60 = 3060 mt
No of Earth wire = 1x1000+2%(sag) = 1000+20 = 1020 mt
Length of Barbed wire = πr^2 h x No of Poles x 60
=3.14x 0.15x13x60
= 367.38 mt

Case II: The ACSR Conductors in Case I is required to be replaced by areal bunched cable at same specification

V_L= 11KV 3-phase 50Hz

Length of RCC Pole = 10 mt

ACSR Conductor = 6/1 x 2.59 mm

Length of 11KV Line = 100 mt

Avg Span of Line = 100 mt

No. of Spans = 1000/10 = 10 Nos

No. of Poles = 10+1 = 11 Nos
Here first and last poles will be double poles.
So total No of Poles = 11+2 = 13 Nos
No of Conductor = 3 Nos
Length of Line Conductor = 3x1000 + 2% = 3000+60 = 3060 mt
No of Earth wire = 1x1000+2%(sag) = 1000+20 = 1020 mt
Length of Barbed wire $= \pi r^2 h$ x No of Poles x 60
=3.14x 0.15x13x60
= 367.38 mt

S.N.	**Material With Specification**	**Quantity**		**Per unit Cost**		**Cost**	
		Q	**U**	**Rs**	**p**	**Rs**	**p**
1	RCC POLE (1000cmx125mmx150mm)	13	Nos	2200	00	28600	00
2	Cross Arm (100x50x8), 1.5m long MS Channel for Single Pole	9	Nos	175	00	1575	00
3	Cross Arm (100x50x8), 2.2m long MS Channel for Double Pole	2	Nos	225	00	450	00
4	Safety Cross Arm (100x50x8 mm), 2.2m long MS Channel for Crossing Pole	4	Nos	220	00	880	00
5	Angle 50x50x6 for 4 BrassRing	15.2	mt	40	00	608	00
6	Cross Arm clamp	25	Nos	30	00	750	00
7	Base Stone 300x300x7.5mm	13	Nos	25	00	325	00
8	11KV Pin insulator with clamp	30	Nos	50	00	1500	00
9	11KV Disc insulator with clamp	6	Nos	75	00	450	00
10	E-Clamp	9	Nos	20	00	180	00
11	6/1.2x2.59 ACSR Conductor	3060	mt	6	40	19584	00
12	6 SWG GI Wire	1020	mt	3	00	3060	00
13	8 SWG GI Wire	1428	mt	2	00	2856	00
14	10 SWG GI Wire	80.5	mt	1	20	96	60
15	12x110mm I-Bolt	16	Nos	10	00	160	00
16	Barbade Wire	367.4	mt	1	00	367.4	00
17	Earth Clamp	11	Nos	20	00	220	00
18	Pipe Earthing Set	4	Nos	400	00	1600	00
19	Stay Wire Arrangement set	8	Nos	325	00	2600	00
20	Danger Board with clamp	11	Nos	30	00	330	00
21	Aluminum Tape (0.77x6.4mm)	90	mt	1	20	108	00
22	Bolt, Nut, Washer	N/A	Nos	100	00	100	00
23	Cement Concrete 1:2:4	6	m^3	200	00	1200	00
24	11KV Lightening Arrester	1	Nos	2000	00	2000	00
		Total Cost:				41028	39

Total Installation Cost of Overhead Line of a Single Segment of Single Village
= Material Cost + Labor cost 10% + Overhead Charges 12% + Sudden Cost 5%
=41028.39+ 4102.83+4923.40+2051.42
=52106.04

Total Project Cost = 52106.04 x 11 = 573166.44

Chapter 7: CONCLUSION & FUTURE SCOPE 43-44

7.1 CONCLUSION 43

7.2 FUTURE SCOPE 44

CHAPTER 7: CONCLUSION AND FUTURE SCOPE

This chapter is the valedictory of our project thesis in which we wrote the final conclusion of our Project illustrating the result along-with the short discussion about the future scope of our presented model.

7.1 CONCLUSION:

Estimating serves a number of purposes in the Installation process of transmission line focused on preparation of bids and cost control. The role of the estimator includes preparing conceptual estimates, preliminary estimates, pre-bid estimates, post-bid estimates, cost control, final project cost, cost on the operating construction period and cost of remodeling or demolition of the construction.

This thesis may be considered generally acceptable not only as an Standard working guideline but also for cost estimating principle manual to the extent that most engineers would generally accept them as a base for good estimating practice. Others are welcome to state their own view of acceptable principles and practices, because it is through such discourse that general principles and good practice are defined and become accepted by the profession.

This work is also Based on the market survey, most recent works are more concentrated on using data collected from market during the whole process of market analysis and research.

The effective discussion on transmission line stringing for steel lattice transmission tower structure, RCC Poles & Wooden Poles plays a vital role in its performance. Narrow based steel lattice transmission tower considered in this project can safely withstand the design wind load and actually load acting on tower. The bottom tier members have more role in performance of the tower in taking axial forces and the members supporting the cables are likely to have localized role.

The vertical members are more prominent in taking the loads of the tower than the horizontal and diagonal members, the members supporting the cables at higher elevations are likely to have larger influence on the behavior of the tower structure. The effect of twisting moment of the intact structure is not significant. The Geometry parameters of the tower can efficiently be treated as design Variables and considerable weight reduction can often be achieved as a result of geometry changes. The tower with angle section and X-bracing has the greater reduction in weight after optimization . Tube section is not economic to use in this type of transmission tower. Total weight of tower considering weight of nut bolts, anchor bolts, hardware etc works out to 30 to 35 Tonne.

7.2 FUTURE SCOPE

Power is the basic key for growth of any country's economy. The increased demand of electricity, need to optimize the utilization of power generation capacity and increase in the interconnections are the major issues with which power sector is dealing with. Energy consumption per person is also rising tremendously in developing countries. However, installing a new power plant cannot be a solution every time. Dense population, availability of land, initial and installation cost can be the major issues in this case.

As we know that the power system industries always require not only the experienced & technically skilled candidate but also require a standard installation procedure to provide the best guidelines to it's employees for all of working projects under it. So, this report may be considered as a full-flash sample guideline for Cost estimation, Operating Steps for Installation & a technical manual for specification of various components used in any OH Transmission line Project. Also the three separate manual can be developed considering these three aforesaid things as per requirement in future.

Additionally, it is beneficial for bids and cost control while calling upon a tender through a public notice on newspapers.

REFERANCES

REFERENCE

[1] Holland H. Farr, “Transmission Line Design Manual” Edition 1 (1980) By Water Resources Technical Publication, US Department of Inteerior

[2] Brook M., Estimating and Tandering for Construction Work. Butterworth-Heinemann, Oxford, UK, 2008.

[3] Venkataraman R., Pinto J., Cost and Value Management in Projects. John Wiley a. Sons, Inc., Hoboken, New Jersey, 2008.

[4] Antohie E., Economia Construcţiilor. Edit. Acad. „Teiu Botez”, Iaşi, 2009.

[5] Transmission Line General Requirements Including Typical Overhead Line Structures Document Number: 1-03-FR-09, VERSION 1.0 June 2018/

[6] JOINT VENTURE OF RINL & POWERGRID TECHNO ECONOMIC FEASIBILITY REPORT (TEFR) ON TRANSMISSION LINE TOWER (TLT) MANUFACTURING COMPLEX by MECON LIMITED, RANCHI-834002, JHARKHAND July’ 2014.

[7] THE ROLE OF ESTIMATION ON CONSTRUCTION LIFE CYCLE BY EDUARD ANTOHIE, Bul. Inst. Polit. Iaşi, t. LVI (LX), f. 1, 2010.

[8] Transmission Cost Estimation Guide – MTEP19

[9] GI Lattice Structure for Transmission Lines MPTCL by BHEL Transmission Project Management Delhi.

[10] COST-ESTIMATING PRINCIPLES By Robert I. Carr,1 Fellow, ASCE, Journal of Construction Engineering and Management, Vol. 115, No. 4, December, 1989. ©ASCE, ISSN 0733-9364/89/0004-0545 Paper No. 24107.

[11] Technical Report on Practical experience of an electrical engineer in rural electrification by Samundra Gurung King Mongkut's University of Technology Thonburi, May 2015 DOI: 10.13140/RG.2.1.1992.8161

[12] INDIAN ELECTRICITY RULES 1956 by Gazette of India, Pt II(3), Section 38 Act 1910 dated on 26-06-1956.

[13] Load generation balance report 2018-19 by Central Electricity Authority, Ministry of Power, Government of India (in Fulfilment of CEA's Obligation under section 73(A) of Electricity ACT, 2003

[14] Gopi Sudam Punse, Analysis and Design of Transmission Tower Published on International Journal of Modern Engineering Research (IJMER) ISSN: 2249–6645 | www.ijmer.com | Vol. 4 | Iss. 1 | Jan. 2014 |P.N. 116-138|

[15] TECHNICAL SPECIFICATION MANUAL FOR DETAILED SURVEYING By using Modern Survey Techniques For 400 KV Transmission Lines by KARNATAKA POWER TRANSMISSION CORPORATION LIMITED Dated on 03.03.2014

[16] TECHNICAL SPECIFICATIONS FOR AERIAL BUNCHED CABLES FOR OVERHEAD DISTRIBUTION by BIS Technical Specification Manual

[17] Proposed Southline Transmission Line Project (Volume 1 of 4) by The Bureau of Land Management & Western Area Power Administration on March 2014

[18] TECHNICAL SPECIFICATION FOR LINE & ERECTION VOL-II(TS) Page 1-40

[19] Brian C. Wadell, Transmission Line Design Handbook, Published by Artech Print on Demand, Year: 1991 ISBN: 9780890064368,0890064369

[20] Li, Zuyi; Yamin, Hatim; Shahidehpour, M, Market operations in electric power systems: forecasting, scheduling, and risk management Publisher: Institute of Electrical and Electronics Engineers, Wiley-Interscience, Year: 2002, ISBN: 0-471-22412-X,0-471-44337-9, 9780471224129,9780471443377, 9780471463948,0471463949

[21] Turan Gonen, Electric Power Transmission System Engineering: Analysis and Design Published by John Wiley & Sons, Year: 1988, ISBN: 0471859931,9780471859932

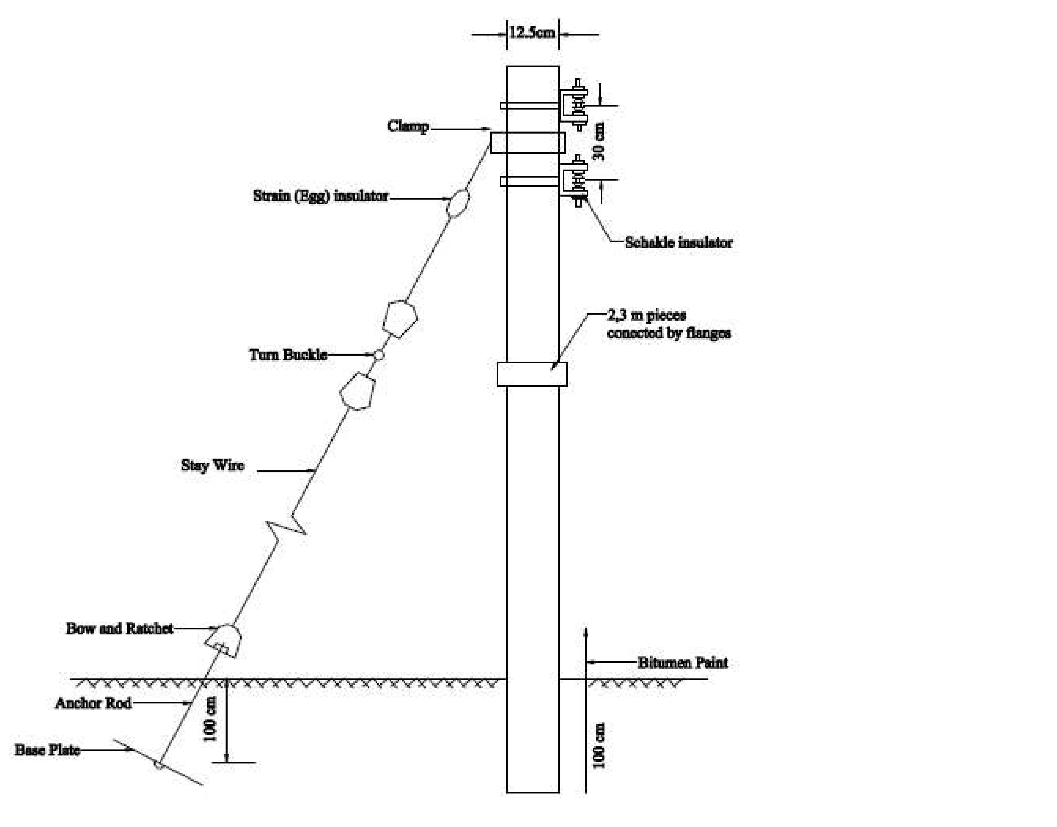
[22] Cost Data Book UP Electricity Regulatory Committee

[23] Draft National Electricity Plan (Vol II) Transmission by Govt. of India, Ministry of Power, Central Electricity Authority, February 2012.

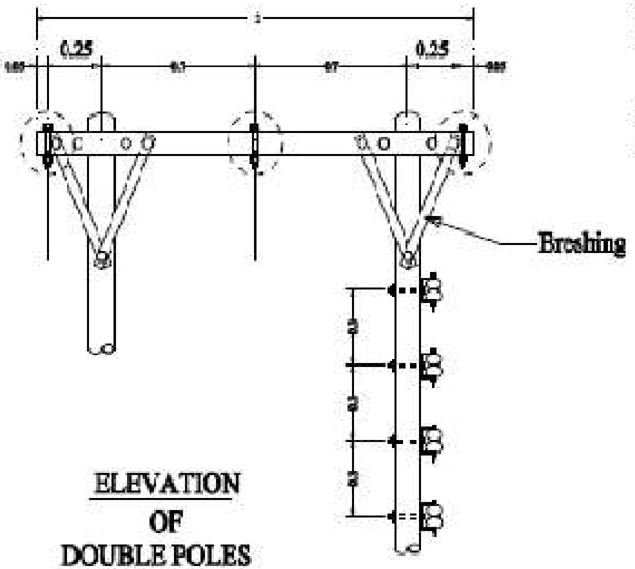
APPENDIX

(Useful Drawings)

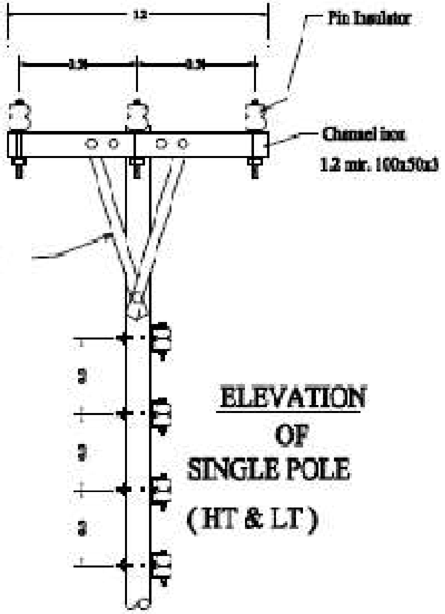
Typical drawings



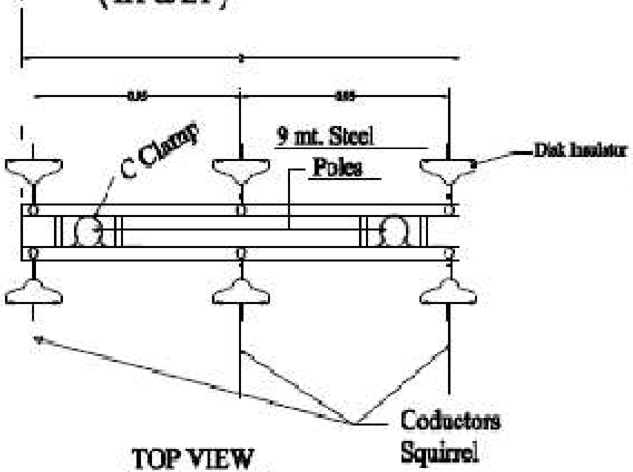
Gramin Urja Tatha Prabidhi Sewa Kendra Pvt. Ltd. G.P.O.Box: 3628 Phone No: 01-5008536/38 Kumaripati, Lalitpur	Tumiya Khola Micro Hydro Project (40 kW) Yamphudin, Taplejung	6 m Steel Pole for Single Phase Distribution Line	Drawn by: Prajwal K. Gautam	Drawing No: E04
			Checked by: Dr. Ramesh K. Maskey	Sheet No.: 13
		Not in Scale	Approved by:	Date: December 8, 2009



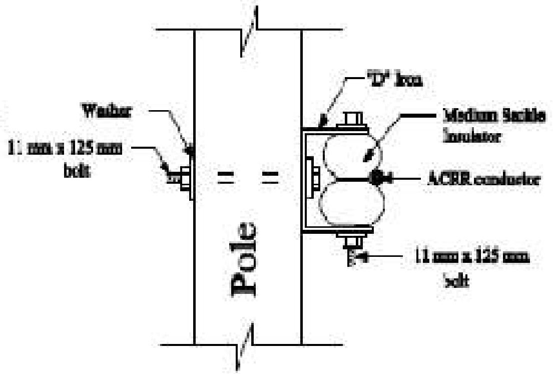
ELEVATION
OF
DOUBLE POLES
(HT & LT)



ELEVATION
OF
SINGLE POLE
(HT & LT)

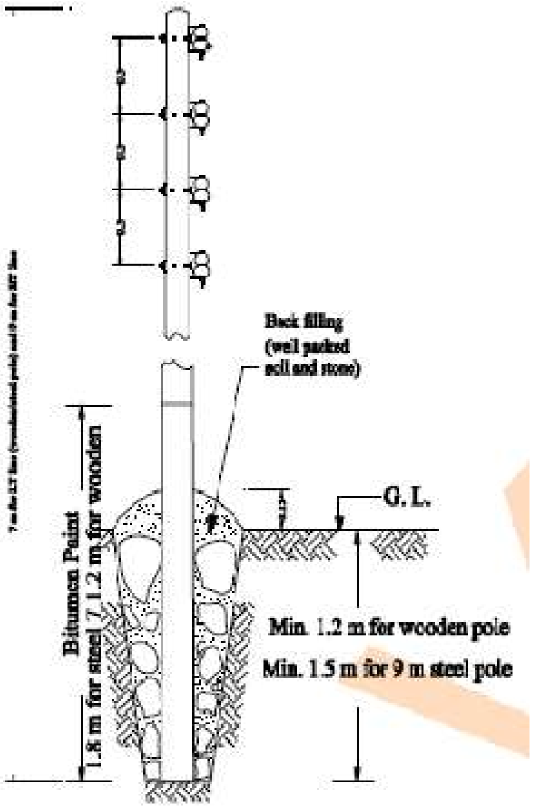


TOP VIEW
OF
DOUBLE (HT) POLES

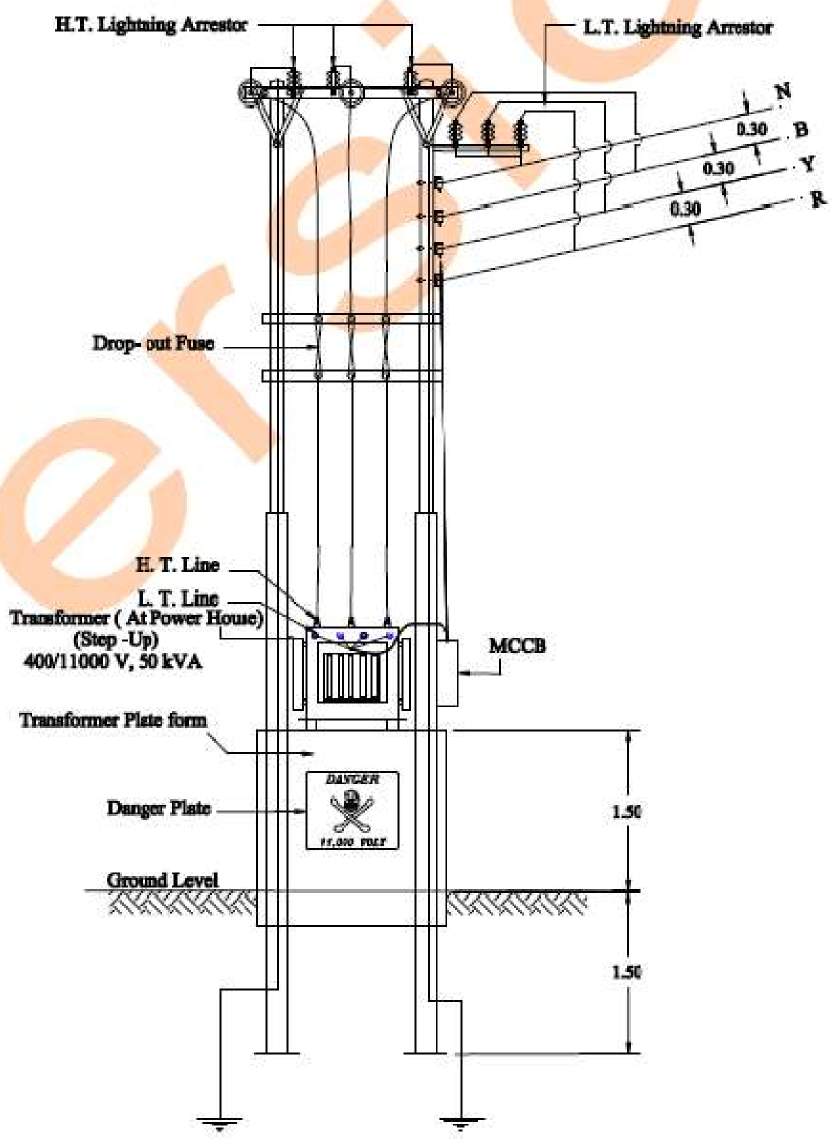


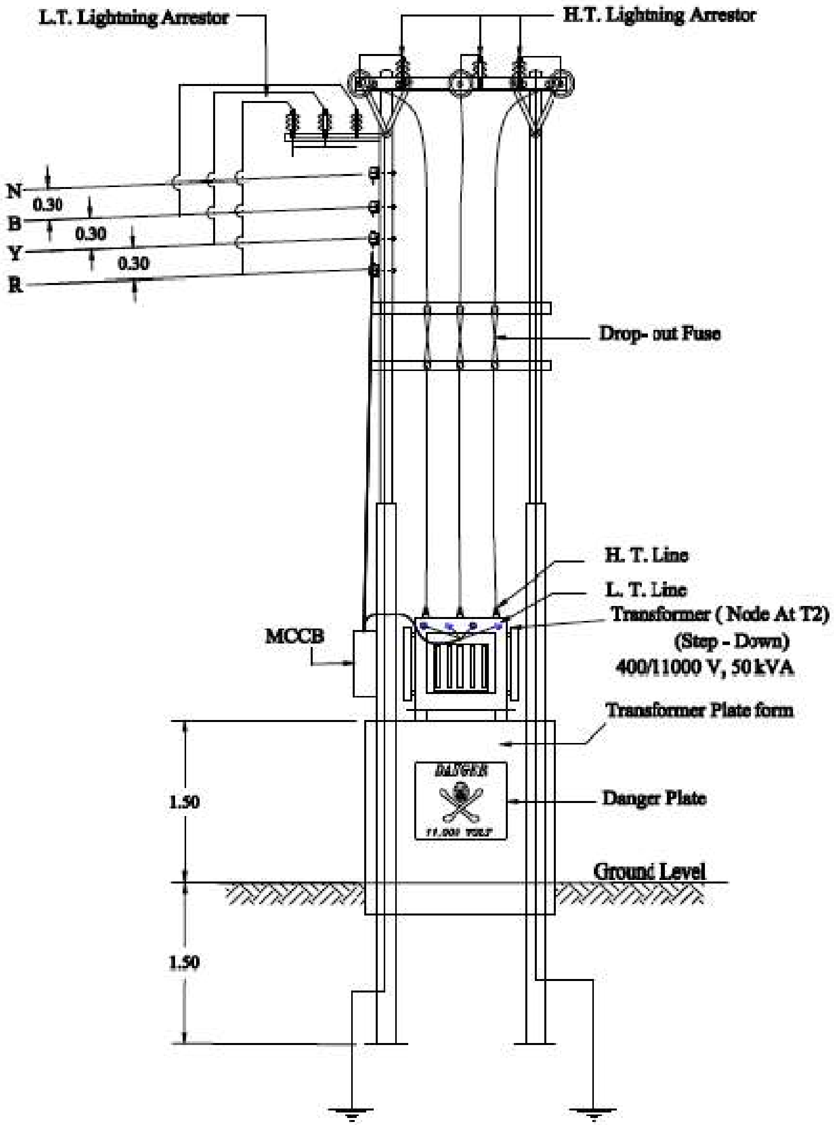
FIXING OF
"D" IRON AND INSULATORS

Scale - 1 : 5


Back filling
(well packed
soil and stone)
G. L.
Bitumen Paint
1.8 m for steel / 1.2 m for wooden
Min. 1.2 m for wooden pole
Min. 1.5 m for 9 m steel pole

POLE ERRECTION


H.T. Lightning Arrestor
L.T. Lightning Arrestor
N
0.30
B
0.30
Y
0.30
R
Drop- out Fuse
H. T. Line
L. T. Line
Transformer (At Power House)
(Step -Up)
400/11000 V, 50 kVA
MCCB
Transformer Plate form
DANGER
11,000 VOLT
Danger Plate
Ground Level
1.50
1.50


L.T. Lightning Arrestor
H.T. Lightning Arrestor
N
0.30
B
0.30
Y
0.30
R
Drop- out Fuse
H. T. Line
L. T. Line
Transformer (Node At T2)
(Step - Down)
400/11000 V, 50 kVA
MCCB
Transformer Plate form
DANGER
11,000 VOLT
Danger Plate
Ground Level
1.50
1.50

Installed Capacity:	22 kW
Total nos of HH:	155
Single length:	5.67 km
3-phase length:	3.89 km
1-phase length:	1.78 km
Ligthening Arrestors:	24 nos., 0.5 kV
Earthing:	13 nos
Pole:	Wooden, 110 nos-8 m ht 51 nos-7 m ht
Insulator:	Shackle type Small size-583 nos Medium size-12 nos
Stay wire:	32 nos

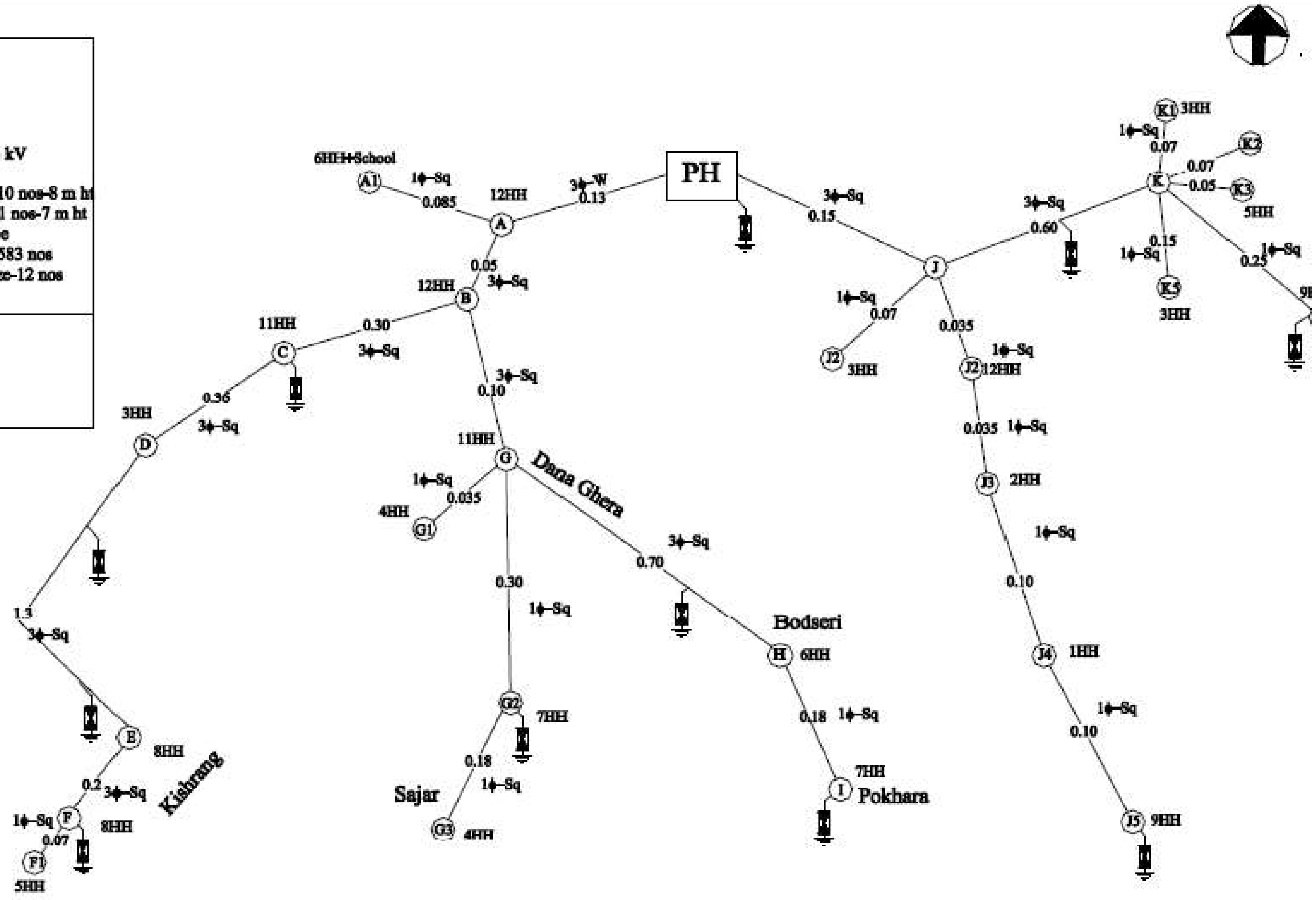
Conductor Type & Length:

Squirrel(km)	20.46
Gopher(km)	0.143
Wessel(km)	0.492

NOTE: Length in km

LEGEND

L.A & Earthing



Prepared By: GREAT Nepal Pvt. Ltd
GPO Box : 9957 Ktm , PH: 01-5011013, Fax:01-5011006
e-mail: gridnepal@wlesuse.org.np

Ghusbang Khola Micro Hydropower System
Seram VDC, Rolpa

Prepared For:
District Development Committee
District Energy & Environment Section
(DDC/DEES)
Rolpa District

Scale As Shown

Transmission and Distribution

Drawn By: Sudip Shrestha
Checked By: Prakash Gurung
Design By: Sudip Shrestha
Checked By: Guna Raj Dhakal

Date:066/05/3
Drawing No: 1
Sheet No: 1/1